US Army Corps
of Engineers

Sacramento District
South Pacific Division

Reconnaissance Report

Washoe Valley at Elko, Nevada

October 1992

DEPARTMENT OF THE ARMY
U.S. ARMY ENGINEER DISTRICT, SACRAMENTO
CORPS OF ENGINEERS
1325 J STREET
SACRAMENTO, CALIFORNIA 95814-2922

REPLY TO
ATTENTION OF

Reconnaissance Report

Washoe Valley at Elko, Nevada

October 1992

WASHOE VALLEY AT ELKO, NEVADA

SYLLABUS

This reconnaissance report has been prepared in response to a resolution by the Committee on Public Works and Transportation, U.S. House of Representatives, dated 21 May 1991. The primary objectives of this study were to identify flood and related water resource problems along the Humboldt River in Elko, Nevada; formulate opportunities to resolve these problems; develop a management plan for the feasibility studies; and identify a potential non-Federal sponsor for the feasibility study.

The general study area is the city of Elko, Nevada. The specific area of investigation is along the Humboldt River from just upstream of the 12th Street bridge to downstream of the Bullion Road bridge. The primary water-related problem is flooding along the Humboldt River, caused by winter rain on snow and/or low elevation snowmelt, spring snowmelt with high elevation rain, and summer cloudbursts. A cloudburst flood in September 1990 caused Panorama Wash to overflow its banks, resulting in damages to homes and other structures in south Elko. About 1,000 people reside in the 100-year flood plain; damageable property is estimated at $12.5 million.

Studies tended to show that (1) areas on the north side of the Humboldt generally have at least a 100-year level of flood protection and (2) the area on the south side of the Humboldt downstream from 12th Street has only about a 33-year level of flood protection.

There is a need for increased water supply, hydropower, recreation, and wildlife preservation in the Elko area. However, only incidental recreation development as it relates to a potential flood control project can be included.

Various measures were identified to help reduce potential flooding primarily from the Humboldt River. The most effective measure was formulated into an action plan providing a 100-year level of flood protection. With this plan, 4,610 feet of levee on the south bank of the Humboldt River downstream of the 12th Street bridge would be upgraded to provide 100-year protection and 820 feet of new levee would be constructed to tie into the existing levee. Culverts would be constructed just downstream of the 12th Street bridge through the south Humboldt River levee to convey floodflows away from the ponded area behind the upgraded levee. Two additional culverts would be installed--one near the pedestrian bridge and another through the tie-back levee. A 1-mile paved bicycle/pedestrian trail on top of the levee would be incorporated into this alternative.

The first costs of this alternative is estimated at $1.2 million, and the benefit-cost ratio is 1.7.

A number of study conclusions are presented. Three primary conclusions are that (1) the flood threat to and on the south side of the Humboldt River in Elko is serious, (2) solutions to resolve this problem are economically feasible, (3) the requirements for completing the reconnaissance phase have been fulfilled, and (4) feasibility studies should proceed under authority of Section 205 of the Flood Control Act of 1948.

RECONNAISSANCE REPORT

WASHOE VALLEY AT ELKO, NEVADA

TABLE OF CONTENTS

LIST OF TABLES

LIST OF PLATES

ENVIRONMENTAL EVALUATION

LIST OF ATTACHMENTS

RECONNAISSANCE REPORT

WASHOE VALLEY AT ELKO, NEVADA

CHAPTER I - INTRODUCTION

BACKGROUND

The Elko area has experienced flooding from winter rain on snow and/or snowmelt, spring snowmelt, and summer cloudbursts. Due to significant population growth in flood prone areas, the city of Elko by letter dated April 23, 1986 (Attachment E), requested a reconnaissance study and indicated willingness to consider further cost sharing of flood control improvements. There have been requests from the Nevada congressional representative for help in resolving the flood problems in Elko. This report is in response to those requests.

PURPOSE AND SCOPE

This report is to present the results of a reconnaissance-level evaluation of flood and related water resource problems along the Humboldt River in Elko, Nevada. The focus of the studies was to:

- Identify flood and related water resource problems and opportunities.
- Identify potential measures to address the problems and opportunities.
- Determine the potential economic feasibility of alternatives to resolve the problems identified.
- Determine the scope and cost of a potential feasibility study.
- Determine if there is a non-Federal sponsor willing to share in the cost of a potential feasibility study.
- Determine the Federal interest in proceeding into the feasibility phase of study.

AUTHORITY

As a result of widespread flooding in various locations in 1983, the House Committee on Public Works and Transportation in August 1984 adopted a resolution directing the Corps to review findings of previous studies, evaluate flood prone areas, and investigate flood problems in other locations. That resolution expired in 1990. Subsequently, the city of Elko requested through its congressional representative that the city's flood problems be investigated to determine if there is a Federal interest in solving the problems. Authorization for this study is a Resolution by the Committee on Public Works and Transportation, U.S. House of Representatives, dated 21 May 1991, quoted below.

> Resolved by the Committee on Public Works and Transportation of the United States House of Representatives, That the Board of Engineers for Rivers and Harbors, is requested to review the reports of the Chief of Engineers on the Humboldt River and Tributaries, Nevada, published as House Document 586, Eighty-first Congress, Second Session; Truckee River and Tributaries, California and Nevada, published as House Document 497, Eighty-third Congress, Second Session; Gleason Creek, Nevada, published as House Document 388, Eighty-sixth Congress, Second Session; and other pertinent reports, to determine whether modifications of the recommendations contained therein are advisable at the present time, in the interest of flood control and other purposes, including multipurpose reservoir and local protection projects, with particular reference to providing flood protection in the vicinity of Washoe Valley, Elko, Ely, Lovelock, Winnemucca, Austin, Eureka, and Battle Mountain, Nevada.

Reconnaissance-level studies of the other areas listed the Washoe Valley authority will be accomplished as funds and specific authority are provided.

PRIOR STUDIES AND REPORTS

Several pertinent prior studies and reports on the Humboldt River and Tributaries, Nevada, are as follows.

Corps of Engineers

- House Document No. 586, Eighty-First Congress, Second Session, "Humboldt River and Tributaries, Nevada," submitted to Congress on 2 May 1950, recommended the construction of three reservoirs for flood control and water conservation,

minor channel improvements on the Humboldt River, and drainage system in the Lovelock area. The project was authorized by the Flood control Act approved 17 May 1950, pursuant to recommendation in H. D. 586.

- "Restudy of the Humboldt River Project, Nevada," November 1963. This document included an updating of benefits and costs, inclusion of recreation as a project purpose, and determination that the project should be classified in an active status.

- "Design Memorandum No. 1, Hydrology, Humboldt River and Tributaries, Nevada," September 1975, presents hydrologic engineering data and criteria pertinent to the Humboldt basin, including flow-frequency curves, standard project floods, and probable maximum floods.

- "Economic Base Study, Humboldt River and Tributaries, Nevada," September 1975, presented economic and social data and projections for the Humboldt basin. The report is limited to a description of the pertinent economic and sociologic conditions without the authorized project or other action alternatives.

- "Environmental Inventory and Base Assessment, Humboldt River and Tributaries, Nevada," September 1975, provides a broad-based inventory of the natural and socioeconomic environment in the Humboldt basin, describes a no-action future of the region, and identifies the nature and extent of significant project impacts. Some methods of minimizing adverse impacts are identified.

- "Humboldt River and Tributaries, Nevada, Preliminary Feasibility Study," April 1976. The purpose of this study was to update preliminary estimates of benefits and costs for the Humboldt River and Tributaries, Nevada, to determine if a project were economically viable.

U.S. Bureau of Reclamation

- "Northern Nevada Water Augmentation Phase 1 Report," November 1991. This was a joint study by the Bureau of Reclamation (USBR) and the State of Nevada to identify and evaluate methods to increase water supplies and make more efficient use of water available to the area. No area for flood control was studied or recommended in the report for the Humboldt drainage.

U.S. Soil Conservation Service

- "Southside Inventory and Evaluation," prepared for City of Elko, Nevada, by Jiggs Conservation District and

U.S. Department of Agriculture, Soil Conservation Service, March 1978.

Federal Emergency Management Agency (FEMA)

- "Flood Insurance Study, City of Elko, Nevada," August 1, 1983. The study investigated the existence and severity of flood hazards in the city of Elko.

U.S. Department of Transportation

- "Environmental Impact Statement, Elko, Nevada, Railroad Relocation Demonstration Project," February 1975, for the relocation of the Southern Pacific and Western Pacific mainline railroad tracks, including relocation of the Humboldt River (also known as "Project Lifesaver").

- "Railroad - Highway Crossings Demonstration Project, Elko, Nevada, Before and After Study, Final Report," August 1987. The report describes the community needs leading to project authorization and compares the anticipated and actual project accomplishments.

State of Nevada

- "Inventory and Evaluation of Impacts on Fish and Wildlife" and "Analysis of Construction and Operation Impacts," 1974, presented results of an environmental and wildlife impact investigation of the Humboldt River.

COMPLETED WATER RESOURCES-RELATED PROJECTS

Soil Conservation Service Projects

The U.S. Soil Conservation Service (SCS) has constructed three small local floodwater detention structures--the Southside Wash, Fifth Street Wash, and Eight Mile Creek. All include dams, reservoirs, and drainage structures, and all are designed to the 100-year event. (See Plate 2.)

South Fork Reservoir

The South Fork Reservoir Project was completed by the State of Nevada in 1990. This storage reservoir on the South Fork of the Humboldt is a 40,000 acre-foot reservoir used mainly for recreation, but could be used for flood control on a drawdown basis. The confluence of the Humboldt River with the South Fork is just downstream of Elko. (See Plate 1.)

Metropolis Dam

The Metropolis Dam project is a flood control and irrigation structure located about 10 miles north of Wells on Bishop Creek. (Wells is about 50 miles east of Elko.) The dam, constructed by the Pacific Reclamation Water Company in 1912, is presently operated by the Metropolis water users. The design capacity of this unit was 30,000 acre-feet; however, this dam is presently considered unsafe; the control gates are open and storage is restricted. Storage is possible only when the inflow exceeds the outlet conduit capacity. The State of Nevada is conducting a study to determine if the structure could be repaired and the reservoir used for recreation. Early indications are that it will not be repaired. (See Plate 1.)

Project Lifesaver

The Railroad-Highway Crossings Demonstration Project, Elko, Nevada (Project Lifesaver), was authorized by the 1973 Federal Highway Act. This project was a Federally funded project to demonstrate the benefits to highway users, the railroads, and the community of eliminating at-grade railroad crossings in urban areas. Part of this project included relocating and enlarging a reach of the Humboldt River through Elko, including levees and channels. Construction was initiated in 1979 and completed in 1984. The Federal Highway Administration, the Nevada Department of Transportation, the city of Elko, the Western Pacific Railroad Company (now owned by the Union Pacific), and the Southern Pacific Transportation Company provided project funding. (See Plate 2.)

STUDY PARTICIPANTS AND COORDINATION

Coordination was established early in the study with representatives of the city of Elko and Federal, State, and local agencies, including:

Federal Agencies

Fish and Wildlife Service	Geological Survey
Soil Conservation Service	U.S. Bureau of Reclamation

State Agencies

Department of Fish and Game	Nevada State Engineers Office
Department of Transportation	Nevada State Historic Preservation Officer

Elko City Agencies

Engineers Office	Planners Office

CHAPTER II - DESCRIPTION OF THE STUDY AREA

STUDY AREA

The general study area is the city of Elko and vicinity. The primary study area extends along the Humboldt River from just upstream of the 12th Street bridge to downstream of the Bullion bridge. Elko is located in the northeastern portion of Nevada in west-central Elko County, about 289 miles northeast of Reno. (See Plates 1 and 2.)

EXISTING CONDITIONS

Physical Conditions

The Humboldt River basin has an area of approximately 16,700 square miles between the Sierra Nevada and Rocky Mountains in north-central Nevada. (See Plate 1.) Upstream of Elko, Nevada, the drainage area is about 2,800 square miles.

The Humboldt River, the largest stream contained within Nevada, originates in the Ruby Mountains at over 11,000 feet above mean sea level (m.s.l.) and flows southwesterly through steep canyons and broad flood plains. In the vicinity of Elko, the river courses through a trough-like basin between two roughly parallel elongated mountain masses, the River Range to the northwest and the Elko Range to the southeast. The width of the basin ranges from 7 to 9 miles; the lowest part is near the base of the Elko Range. Of the numerous tributaries flowing into the Humboldt River at Elko, the three of primary concern in this study are the Southside Wash, Panorama Wash, and Metzler Wash. (See Plate 2.)

The climate in the Humboldt River basin is arid to semiarid. In the high mountain area, precipitation is greater. Table 1 shows the average precipitation for Elko.

Temperatures range from a high of 107 °F to a low of -43 °F at Elko. The average daily maximum is 62.1 °F and the daily minimum is 30.2 °F.

Water quality concerns on the Humboldt River include concentrations of Suspended Solids, Total Dissolved Solids, Total Phosphorus, and nitrate; sediment transport; and alkali. Widespread alkali conditions in the arid Great Basin affect the quality of Humboldt River water. A low level of rainfall in upland areas and high evaporation rates result in the accumulation of alkali salts in the topsoil. The presence of alkali in surface waters is recurrent, but the amount of leaching

and the concentration of alkali in runoff from rainfall does not significantly degrade water in the Humboldt River or make it unfit for downstream users.

TABLE 1

PERTINENT PRECIPITATION INFORMATION

Station	Elko, Nevada		
Elevation	5,050 (ft m.s.l.)		
Month	Precipitation (inches)		
	Minimum	Average[1]	Maximum
January	0.04	1.16	6.00
February	0.06	0.81	5.50
March	0.04	0.85	3.75
April	0.10	0.70	3.94
May	trace	1.03	4.09
June	trace	0.91	4.08
July	0.0	0.33	2.35
August	trace	0.58	4.61
September	trace	0.47	3.79
October	trace	0.56	2.90
November	trace	0.83	3.74
December	trace	0.98	5.46
Year	4.35	9.21	18.94

[1] From "Climatological Summary," National Weather Service. Mean for the period 1941-1990.

Ambient air quality is generally good, but particulate matter exists from unpaved roads; agricultural, residential, and commercial activities; and wind-blown dust.

Community Profile

From 1980 to 1990, population in the city of Elko increased about 162 percent--from 8,758 to about 23,000. In Elko County, population has more than doubled in the same decade, from 17,269 in 1980 to about 36,700 in 1990. Historically, more than

50 percent of the county population resided in Elko. The tabulation below shows census figures for Elko city and county.

Year	Population	
	Elko City	Elko County
1960 (Census)	7,000	12,000
1970 (Census)	7,620	12,960
1980 (Census)	8,760	17,270
1990 (Dept of Taxation Estimate)	23,000	36,700

As discussed in Chapter III, much of the south side of the Humboldt River in the primary study area is subject to flooding from the Humboldt River. Approximately 1,000 people reside in this area. About 389 structures are in the 100-year flood plain, including 107 single-family residences, 223 mobile homes, 9 commercial buildings, and 3 public buildings.

Overall, Elko has about 3,000 single-family homes, an estimated 1,136 apartments and multi-family dwellings, and about the same number of mobile homes. There are 513 commercial buildings within the city limits.

Elko's economy reflects that of the overall State economy, with service and manufacturing industries providing the bulk of the employment opportunities. In Elko, mining and ranching are also leading industries, in addition to services, manufacturing, and government. Recent population growth is due in part to new mining processes which have resulted in increased employment. About 3,000 jobs are in the mining industry.

Rangeland is the primary agricultural land use in the Humboldt River basin. Livestock are fed through all four seasons. The Forest Service and Bureau of Land Management administer approximately 66 percent of the land in the basin for multiple uses, such as grazing, wildlife habitat, mining, forest products, and recreation.

Principal highways, railroads, and urban areas are located along the river. The natural transportation corridor serves as a major transcontinental route.

Natural Resources

The wide variation in climate, relief, vegetation, parent materials, and age of landscapes within the Humboldt basin has

resulted in many different soil types. In the mountains, the soils are shallow and overlay consolidated or unconsolidated upland materials. The soils in the plains are generally sandy to gravelly, very porous loams. Humus clays and tight alluvial materials exist in the river drainage and the lower valley. Along the substandard portion of the south levee west of the 12th Street bridge, soils appear to be silt or silt with sand; the remainder of the south levee is sand and sand with small gravel.

The reach of the Humboldt River through Elko supports a substantially degraded vegetation community. Before the construction of Project Lifesaver, half of the riverbanks contained willow cover and riparian habitat. According to the Nevada Department of Wildlife, nearly 50 percent of that riparian vegetation was removed during construction of Project Lifesaver. Very little quality riparian vegetation remains, although some young willows have become established on unstable riverbanks. The loss of the riparian vegetation has led to habitat type conversion to upland vegetation, with dry site grasses, forbs, and upland shrubs now growing on the existing levee.

Vegetation along the banks of the Humboldt River just outside of the Elko city limits is largely agricultural, primarily harvested hay meadows. Agricultural activities removed much of the natural riparian vegetation from along the river and in the flood plain. Other vegetation types along the Humboldt include bulrush, cattails, willows, and wildrye.

Wildlife in the study area includes furbearers, upland mammals, nongame mammals, waterfowl, nongame bird species, and amphibians and reptiles.

Wildlife use of existing vegetation along the south levee of the Humboldt River is virtually non-existent and is minimal along the cobble bench between the river channel and the levee. Habitat use just upstream and downstream of the study reach is moderate.

The Fish and Wildlife Service (FWS) has identified one endangered species, the bald eagle, in the study area. FWS believes three candidate species, the white-faced ibis, the loggerhead shrike, and the spotted frog, may frequent the Elko vicinity.

FUTURE CONDITIONS

No major changes are expected to physical conditions in the Elko area. Agriculture and ranching will likely continue as stable economic pursuits, and growth in service and government jobs is expected to increase. Forecasts for mining through the

year 2000 indicate that there are more proven reserves of gold than were being developed in 1987.

The Nevada Department of Taxation projects population in Elko County to grow to 41,000 in 1993 and to 46,700 by 1995. Population has already outstripped previous estimates.

Increased residential development on the south side of the Humboldt is expected within Metzler and Panorama Washes in the future, leading to further reductions in wildlife use of the area. (See Plate 2.) As development and agriculture encroach, habitat along the Humboldt River is likely to remain poor within the project area and continue to decline outside of it. Fish and wildlife resources would likely remain unchanged or worsen as habitat disappears.

CHAPTER III - PROBLEMS AND OPPORTUNITIES

FLOODING

Historic Flood Problems

Flooding in the Humboldt River basin and adjacent areas of the Great Basin can result from (1) winter rain on snow and/or low elevation snowmelt, (2) spring snowmelt with high elevation rain, and (3) summer cloudbursts. Table 2 shows selected historical winter and spring floods. However, little meteorological or hydrological data are available for floods prior to 1914.

Summer cloudbursts caused flooding in June 1918, July-August 1930, August 1941, July-August 1961, August 1968, August 1970, and September 1990. The 1970 and 1990 floods in the Humboldt basin caused serious flooding in urban areas. On August 27, 1970, a summer thunderstorm caused flooding along several tributaries in and adjacent to Elko, resulting in localized flooding and debris deposits. Cloudburst flood peaks have been recorded on many small basins of less than 25 square miles. For larger areas, no overbank cloudburst floods have been recorded by stream gages because flood plain storage and irrigation diversions attenuate flow. The September 1990 event at Elko was due to a cloudburst on the southside tributaries. Although not a large event and not recorded by the National Weather Service, floodflows were greater than the capacity of the Panorama drainage. Sheet flow over the Lamoille Highway coursed through a residential area and filled some basements with water. The Elko Fire Department pumped floodwaters from basements. Damages were not estimated for this event.

Hydrology

Peak flows were estimated for the Humboldt River and southside tributaries. Recorded flows were compiled and flow-frequency curves and hydrographs estimated for various events so that flood problems could be identified and opportunities formulated to reduce the flood problems. Flow-frequency estimates for the Humboldt River are based on an update of the 1975 Corps hydrology study. The rainfall and snowmelt peak flow-frequency curves for the Humboldt River near Elko were updated using 53 years of peak flows. Current computer program HECWRC flow-frequency curves were developed. The all-events peak flow-frequency curve of the Humboldt River near Elko was computed by statistically combining the rainfall and snowmelt peak frequency curve. (See Plate 3.)

TABLE 2

HISTORICAL FLOODS

Date	WINTER FLOODS DESCRIPTION (RAIN-ON-SNOW/LOW ELEVATION SNOWMELT)
Feb 1907	Heavy rains occurred on deep winter snowpack on lower Humboldt basin tributaries below Battle Mountain. No flood records available.
Feb 1910	Rapid melting of low elevation snowpack overlying frozen ground by Pacific chinook. Greatest flood since settlement, estimated 17,000 cfs at Palisade.
Jan 1914	Rain on snow caused flooding from Elko to Winnemucca; 3,100 cfs at Palisade; 2,400 cfs South Fork.
Feb 1921	Rain occurred on unusually heavy snowpack in the upper Humboldt basin and Rock Creek; 4,300 cfs at Palisade.
Jan-Feb 1943	Rain on snow with extensive frozen ground in upper basins; 6,250 cfs at Palisade.
Feb 1962	Rain on snow with frozen ground at low elevations. Greatest flood since 1910, 6,610 cfs at Palisade.
Jan 1969	Rain on snow caused flooding on Little Humboldt River and Martin Creek.
Mar 1983	Rain on snow caused flooding on the Humboldt. Most of the runoff was from low elevation. The flow at Elko was 7,100 cfs.
Feb 1986	This event was created by rainfall on snowmelt. The flow recorded at Elko was 6,410 cfs.

Date	SPRING FLOODS DESCRIPTION (SNOWMELT)
May 1884	Extensive snowmelt flooding aggravated by unusual late spring rainstorms in lower parts of the basin. No flood records available.
Mar 1914	Snowmelt flooding more damaging in some areas than 1917 or 1921, 1,750 cfs at Comus.
Feb-Mar 1917	Flooding on South Fork Humboldt River and Pine Creek, 1,700 cfs South Fork, 3,170 cfs at Palisade.
Mar-Apr 1921	Flooding on upper and middle portions of Humboldt basin, 4,300 cfs at Palisade.
Apr-May 1942	4,000 cfs at Palisade; no records available on lower river.
Apr-May 1952	Unusually clear warm weather combined with record snowpack depths to cause highest recorded snowmelt flood in the basin to date, 6,050 cfs at Palisade.
May 1984	Snowmelt flood or large snowpack, 5790 cfs peak recorded at Elko.

Rainfall peak flow-frequency curves for the Humboldt tributaries of Metzler, Southside, and Panorama Washes were developed using the computer program HEC-1. The hydrographs for these tributaries were also developed. Flow-frequency estimates are summarized in Table 3.

The expected flooding on the Humboldt River would be from either a winter rain on snow or spring snowmelt. However, the floodflows on the tributary streams would be caused by summer

cloudbursts. Accordingly, it is highly improbable that flooding on the Humboldt River and tributaries would be concurrent.

TABLE 3

PEAK FLOW-FREQUENCY ESTIMATES

Stream	Drainage Area (square mile)	Return Interval Peak-Flow (cfs)			
		10-Year	50-Year	100-Year	500-Year
Humboldt	2,774	4,000	8,580	12,100	28,400
Panorama	0.5	60	210	320	780
Southside	1.0	85	310	490	1,210
Metzler	1.7	130	450	700	1,700

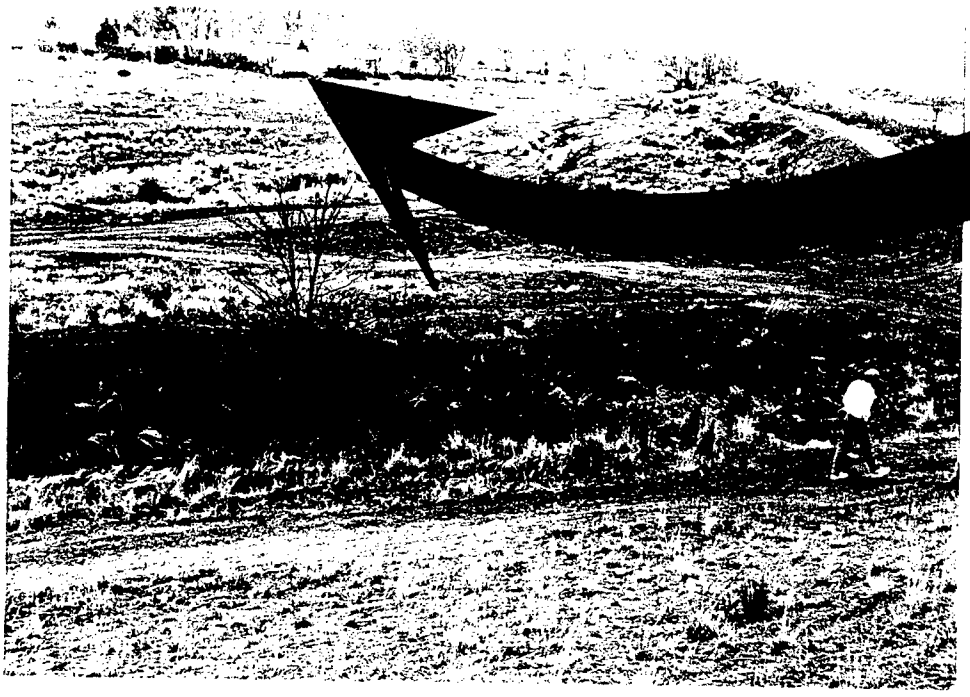
Levee Breaks

Project Lifesaver, the railroad demonstration project, has modified the Humboldt River channel in the Elko area. Part of Project Lifesaver was the relocation of the Humboldt River and two railroad main line tracks. The railroad tracks are located on a levee on the north (right) bank that was constructed as part of Project Lifesaver. Also as part of the project, a 4,600-foot-long levee was constructed on the south bank of the channel downstream of the 12th Street bridge. The levees and channel were sized to convey the 100-year floodflows. However, current hydraulic and related studies indicate the project achieved a lesser degree of protection.

The most critical section of the south (left) bank levee is just downstream of the 12th Street bridge and extends approximately 800 feet downstream from the bridge. The levee cross section is inadequate, with a narrow crown approximately 10 feet wide and side slopes nearly 1 vertical on 1 horizontal. Approximately 100 feet downstream of 12th Street, the levee crown is about 3 feet lower than the crown of the rest of the levee. Upgraded riprap protects the waterside. The levee surface material appears to be predominantly silt with a small amount of fine sand. Fine grained, cohesionless soils such as these are highly erodible. With its steep slope and narrow crown, this section of levee is highly susceptible to seepage and possible failure by sloughing during high floodflows. At water-surface elevations higher than the existing riprap, the physical effectiveness of the levee is uncertain.

The estimated Probable Non-Failure Point (PNP) is the highest vertical water stage (elevation) on the levee such that it is highly likely the levee would not fail. The PNP for this levee was determined to be the point at which the levee is under minimal stress, at or near adjacent ground elevation. The Probable Failure Point (PFP) is the water stage (elevation) on the levee such that it is highly likely that the levee would fail. The PFP appeared to be approximately 4 feet below the existing levee crest, or about 1 foot below the levee crown elevation at the critical low section just downstream of the 12th Street bridge. The levee failure point for this study was taken as the midpoint between the PFP and the PNP. Current water surface studies indicate that the historical high water elevation passed by this levee, corresponding to approximately 7,100 cubic feet per second (cfs) (33-year event) is about the midpoint between the PNP and the PFP. Projecting highly likely levee failure at water surface elevations above the historical water elevation appears reasonable for the left bank. The top photo on the following page shows the south levee subject to failure. The flow would breach the levee and the low point downstream of the bridge and pond behind the levee to the elevation of the river. The approach road to the 5th Street bridge would act as a levee for the ponded area. The channel profile is shown on Plate 4, and a cross section of the left bank levee downstream of the 12th Street bridge is shown on Plate 5.

The levee on the north (right) bank of the Humboldt River was also investigated. This levee was built in connection with relocating the Western Pacific Railroad tracks during construction of Project Lifesaver. The levee is generally higher than the south bank levee. The right bank consists of a railroad embankment approximately 50 feet wide with two sets of tracks, an earthen access road about 30 feet wide, and a soundwall about 8 feet high to the north of the access road. The PNP was estimated to be approximately 2 to 3 feet below the elevation of the railroad tracks at the base of the ballast. This is also the elevation of the base of the soundwall. The ballast would not retain floodflows and would drain freely. The PFP would be about the same elevation as the railroad tracks. The soundwall would probably not fail until the water was incidentally retained 2 to 2.5 feet up from the base. The failure point for economic studies was taken as the midpoint of the PNP and the PFP. Accordingly, the levee and soundwall on the north bank would provide protection to about 13,000 cfs. Flooding from this event would not likely be great as only water seeping through the ballast would cause ponding. However, when water reaches the top of the tracks, it is believed the levee would fail as well causing significant flooding. This would occur with a flow of about 16,000 cfs (166-year event). The lower photo on the next page shows the north levee.



HUMBOLDT RIVER AT ELKO, SOUTH (LEFT) BANK LEVEE.
LOOKING DOWNSTREAM (WEST) FROM THE 12TH STREET
BRIDGE AT THE PROBABLE AREA OF FAILURE TOWARD
MAJOR DEVELOPMENT TO THE SOUTHWEST.

HUMBOLDT RIVER AT ELKO NEAR PEDESTRIAN BRIDGE.
LOOKING UPSTREAM TO THE NORTHEAST.
HIGH LEVEE WITH RAILROAD TRACKS AND SOUNDWALLS ON
THE NORTH SIDE OF THE HUMBOLDT RIVER.

Flood Plains

Flood plain delineations for the problem areas along the Humboldt River were based on updated Corps hydrology and topography, including river cross sections. The scale of the mapping is 1 inch=400 feet with 4-foot contours. The cross sections were developed from data prepared by an engineering firm for a concurrent FEMA flood insurance study. Water surface elevations for the Humboldt River were calculated using the HEC-2 backwater computer program. For the south side, 33-, 50-, 100-, and 500-year flood plains were developed, assuming a break in the levee just downstream of the 12th Street bridge and ponding behind the levee. The 166-year and 500-year flood plains were also developed for the north side of the Humboldt. From the water surface elevation of the ponded areas and the topography, respective depths of flooding were estimated for use in economic and plan formulation studies. The flood plains are shown on Plate 6.

Tributary Streams

Northside Tributaries. - Flooding from the northside tributaries at Elko has generally been resolved in previous flood protection projects. (Both the 5th Street and Eight Mile drainages have flood control basins.) The northside tributaries also have a one in 10-year flow of less than 800 cfs. Accordingly, no detailed mapping for flood plain delineation was done on the northside tributaries as part of this investigation.

Southside Tributaries. - Several tributaries drain the area to the south of the Humboldt River at Elko. During major cloudbursts, high flows from these tributaries can cause flooding and significant property damage to developments south of the south levee to the Humboldt River. Panorama Wash is a small drainage with an existing culvert to convey flows from near the Lamoille Highway to the Humboldt River. The culvert has a potential capacity of 30 cfs, much below even the 10-year estimated 60 cfs cloudburst flow. However, the culvert is often obstructed with debris and flow capacity is minimal.

As mentioned, the SCS constructed a small detention basin with pipe culvert to convey the flows to the Humboldt River from Southside Wash. Although designed to convey floodflows up to the expected one in 100-year event, the detention basin currently needs maintenance. However, for this investigation, it was assumed that the maintenance will be completed and the basin will provide protection to the 100-year event.

Metzler Wash also has drainage to the south of the Humboldt River, and floodflows are diverted behind the Humboldt River levee. The original natural drainage would not have floodflows behind the levee. However, recent development of both a highway

and housing interferes with the natural drainage and impedes the natural flows.

Ponding south of the Humboldt River was analyzed based on field evaluation, observation, Corps hydrology, available topographic data, and flow routing studies ('XRATE Flow Routing Model). It was found that the south levee can also be expected to fail to the north from the ponding behind the levee. The failure location would likely be just upstream of the 5th Street bridge. The breakpoint was estimated to be the midpoint between the PNP and the PFP. For the 100-year event, the ponded volume to reach the break point would be about 62 acre-feet and would be reached in about 3 hours. Assuming that failure was not instantaneous, the peak volume in the ponded area--76 acre-feet for a 100-year event--would be reached in about 4.25 hours.

Economic Studies

Average annual flood damages were estimated for the Humboldt River and southside tributary streams. The estimates were made on the basis of existing conditions only; no future growth was included. A 50-year period of analysis, 8-1/2 percent interest rate, and October 1992 price levels were assumed for the analysis. Average annual damages and benefits were developed in accordance with ER 1105-2-100.

Although there are agricultural lands within the total basin and much of the economy for the Humboldt is related to agriculture, no agricultural lands are within the flood plains analyzed in this study. Therefore, crop damages were not evaluated. For the economic evaluation, the areas on the south overbank area were analyzed. The flooding here is from snowmelt and general rain events on the Humboldt River; for the tributary streams, flooding is from cloudbursts. Although some structures are common to both areas that will be flooded, the events would happen at different times of the year and were separated for economic analysis.

Elko primarily consists of single-family residential and mobile homes; however, some commercial and public structures and light industrial structures are in the flood plain. Elko serves as the County Seat for Elko County.

As mentioned earlier, Project Lifesaver reduced the potential for flooding, but there is still potential for extensive flood damages. There have been past floods at Elko; however, damages were not documented on the south overbank of the Humboldt River or the tributary streams.

Inventory of Damageable Structures. - In January and May 1992, all damageable structures were inventoried in the field. Existing damageable units for each area by specific flood plain and land use category, as well as their values and damage potential, are discussed in this report. Table 4 shows the number of structures in the flood plains within each land use category.

TABLE 4

NUMBER OF STRUCTURES IN THE FLOOD PLAIN

Humboldt River South Bank	33-year	100-year	500-year
Single-Family Residential	101	107	120
Multi-Family Residential [1]	2	2	2
Mobile Homes	113	223	380
Commercial	7	9	10
Public	3	3	3
Sheds	43	45	62
Total	269	389	577
Humboldt River North Bank	**166-year**	**500-year**	
Single-Family Residential	88	102	
Multi-Family Residential [1]	2	3	
Mobile Homes	91	91	
Commercial	31	38	
Public	0	0	
Sheds	11	11	
Total	223	245	
Southside Tributaries	**50-year**	**100-year**	**500-year**
Single-Family Residential	41	84	148
Multi-Family Residential [1]	2	4	6
Mobile Homes	114	165	429
Commercial	1	1	17
Public	3	3	6
Sheds	13	33	88
Total	174	290	694

[1] Assumes 12 units/structure.

Value of Damageable Property. - The market value of damageable property for the flood plain structures was determined for the Humboldt River and southside tributary streams. Property values consist of replacement costs less depreciation. After

evaluating the values shown on the assessor's rolls, an inventory was taken, and the values were reassessed by using the Marshall and Swift appraisal manual, sales documentation, and conversations with local residents, proprietors, and real estate appraisers. The values reflect the replacement cost (less depreciation) of the structures, as well as all inventory, fixtures, and equipment. The property values for each category are shown in Table 5.

TABLE 5

ESTIMATED VALUES OF DAMAGEABLE STRUCTURES
AND THEIR CONTENTS
($1,000)

Humboldt River South Bank	33-year	100-year	500-year
Single-Family Residential	5,475	6,045	6,390
Multi-Family Residential [1]	270	270	270
Mobile Homes	2,807	4,670	10,227
Commercial	1,275	1,460	1,533
Public	0	0	0
Sheds	95	99	147
Total	9,922	12,544	18,567
Humboldt River North Bank	**166-year**	**500-year**	
Single-Family Residential	4,020	4,695	
Multi-Family Residential [1]	135	225	
Mobile Homes	2,355	2,355	
Commercial	9,408	11,520	
Public	0	0	
Sheds	44	44	
Total	15,962	18,839	
Southside Tributaries	**50-year**	**100-year**	**500-year**
Single-Family Residential	2,295	4,530	7,925
Multi-Family Residential [1]	1,200	1,935	2,670
Mobile Homes	3,654	4,928	12,164
Commercial	85	85	3,288
Public	195	195	2,365
Sheds	29	73	198
Total	7,458	11,746	28,610

[1] Assumes 12 units/structure

The value of residential structures includes all structures and contents of single-family dwellings. Multi-family dwellings, sheds, and mobile homes are categorized independently of the residential structures because they are distinctive and abundant. Contents of all dwellings are assessed at 50 percent of the structural value. Contents of sheds are assessed at 10 percent of the structure value.

Public and semi-public facilities include buildings such as schools and churches and their contents and other facilities, including equipment and furnishings owned or operated by Federal, State, county, or local governmental units. Content values of all public, semi-public, and commercial buildings are determined on an individual basis since their respective inventories are different.

Flood Damages. - Based on the data presented in preceding paragraphs, flood damages were estimated by determining relationships between damageable property values and the anticipated depths of flooding. Depths of flooding range from sheetflow to 5 feet in the Humboldt River flood plain and from sheetflow to 3.5 feet in the tributary flood plains.

To estimate accurately structural and content damages, depth-damage relationships were used to determine the damages incurred under different depths of flooding as a percentage of the total value of damageable property. The depth-damage relationships for residential, multi-residential, mobile home, commercial, and public categories were derived from the 1988 FEMA and the 1969 Tennessee Valley Authority curves.

The types of flood damages addressed are those physical damages that are caused by inundation and losses and costs incurred preparing for and fighting floods. These damages include structural and content damages such as inventory, fixtures, and equipment; automobile damages; and emergency costs. Intangible damages, such as loss of life, impairment of health and living conditions, and other impairments that cannot be quantified monetarily, have been excluded from the damage analysis.

Automobile damages are the damages to automobiles which are not removed prior to flooding.

Emergency costs are costs that are incurred during flood emergencies for evacuation and reoccupation, flood fighting, disaster relief, and extra duty for police, fire, and military units. Evacuation costs were based on Red Cross data and were contingent upon the duration of flooding. Flood fighting and all other emergency costs were based on data from local emergency officials. FEMA officials estimated that flood victims would be able to reenter their homes in 30 days.

Table 6 shows the estimated damages for the 33-, 50- and 100-year events for the south bank of the Humboldt River; the 166- and 500-year for the north bank; and the 50-, 100-, and 500-year for the tributary streams. The damages include those to structures and contents; emergency flood fighting and evacuation; automobile damages (tributaries only); and road damages.

Average Annual Damages. - Average annual damages are the expected value of damages for a given economic condition and point in time. The damages are determined by weighing the estimated damages from varying degrees of flooding by their probability of occurrence. It is approximated by measuring the area under the damage-frequency curve using standard mathematical integration procedures. This curve is based on both the flow-frequency and flow-damage relationship. Nondamaging flows for the Humboldt River and tributaries are 7,100 cfs for the south bank, 13,000 for the north bank, and 115 cfs for the tributary streams. Probable average annual damages under without-project conditions were estimated using current (1992) data and a base year of 1998.

Average annual equivalent flood damages under existing conditions are summarized in Table 7.

Additional information is provided in Attachment A, the Economic Analysis.

WATER SUPPLY AND HYDROPOWER

Water supply in the Humboldt basin has been a concern for many years, with many disagreements among property owners along the river concerning water rights. The potential sponsor of the study, the city of Elko, uses ground water wells for its total water supply. The city has current water rights or permits to develop a supply that is twice its existing use. Accordingly, water supply in conjunction with flood control is not a priority. In the recent USBR "Northern Nevada Water Augmentation Phase 1 Report," there was no suggestion for additional studies of new multipurpose storage that included water supply and hydropower.

RECREATION

The city of Elko has four parks located throughout the city. The central municipal park generates the major use, whereas the three smaller parks have limited use. The city of Elko has a conceptual recreation plan for the Humboldt River through Elko. Although specific details are unavailable at this time, the city envisions a multipurpose use of river frontage. Because there are currently no recreational facilities along the Humboldt

TABLE 6

TOTAL DAMAGES SUMMARY
($1,000)

Land Use Category - Humboldt River, South Bank	33-year	100-year	500-year
Residential Structure/ Contents	1,245	2,134	2,509
Multi-Residential Structure/Contents	40	93	101
Mobile Home Structure/ Contents	690	2,934	7,712
Commercial Structure/ Contents	347	620	777
Public Structure/ Contents	458	691	910
Sheds	14	36	69
Emergency Costs	642	900	1,469
Road Damages	75	111	145
Auto Damages	143	662	1,109
Total	3,654	8,181	14,801

Land Use Category - Humboldt River, North Bank	166-year	500-year	-
Residential Structure/ Contents	1,230	1,524	
Multi-Residential Structure/Contents	34	60	
Mobile Home Structure/ Contents	1,645	1,733	
Commercial Structure/ Contents	3,800	5,587	
Public Structure/ Contents	0	0	
Sheds	7	9	
Emergency Costs	552	623	
Road Damages	89	99	
Auto Damages	389	467	
Total	7,746	10,102	

Land Use Category - Three Tributaries	50-year	100-year	500-year
Residential Structure/ Contents	96	570	1,250
Multi-Residential Structure/Contents	0	107	131
Mobile Home Structure/ Contents	0	12	1,026
Commercial Structure/ Contents	0	0	271
Public Structure/ Contents	11	17	520
Sheds	1	4	16
Emergency Costs	3	13	52
Road Damages	33	54	168
Auto Damages	3	32	161
Total	147	809	3,595

TABLE 7

WITHOUT-PROJECT AVERAGE ANNUAL DAMAGES ($1,000)[1]

Category	Humboldt (North Bank)	Humboldt (South Bank)	Tributaries	Total
Residential	10.7	58.6	16.8	86.1
Multi-Residential	0.1	2.4	1.7	4.2
Mobile Home	13.1	95.1	5.4	113.6
Commercial	36.6	17.1	1.4	55.1
Public	0.0	20.2	3.4	23.6
Sheds	0.1	1.1	0.2	1.4
Emergency Costs	4.6	28.4	0.6	33.6
Roads Damages	0.7	3.2	3.1	7.0
Auto Damages	3.3	17.5	1.2	22.0
Total	69.2	243.6	33.8	346.6

[1] October 1992 prices and conditions at 8-1/2 percent interest rate.

River, the conceptual plan could provide for parks, trails, and nature experiences along the reach from 12th Street bridge to Bullion bridge.

City officials estimate Elko will need additional recreational facilities in the future as it continues to grow. The 1987 Master Plan Update forecast the need for another city park sometime after 1990. The city based that need on a projected 1990 population that was actually exceeded by more than 9,000. Before initiation of the reconnaissance study, local officials expressed to the Corps their interest in recreational facilities along the Humboldt.

NATURAL RESOURCES

Potential future development in the Elko area could lead to further destruction of existing upland vegetation. In conjunction with flood control solutions, enhancement could be considered to improve wildlife resources.

CHAPTER IV - PLAN FORMULATION

The process of developing and evaluating plans to resolve the problems and needs previously identified is discussed in this section. It includes (1) establishing planning objectives, (2) developing formulation criteria, (3) identifying management measures, and (4) formulating and evaluating alternative plans.

PLANNING OBJECTIVES

The problems and opportunities previously discussed were redefined in terms of the planning objectives. They are as follows:

- Reduce flood and flood-related damages along the Humboldt River at Elko, Nevada.

- Provide recreation opportunities in Elko to meet current and future demands in conjunction with meeting the flood control objective.

- Emphasize retention of natural resources in the study area.

FORMULATION CRITERIA

Because the above objectives are fairly broad, several criteria used in plan formulation were developed as follows:

Technical Criteria

- Alternative plans should complement State, county, and other local flood control plans and projects involving study area streams.

- Alternative plans should be consistent with provisions of the National Flood Insurance Program (NFIP).

- Federal participation in implementing plans to address urban flood damage problems will be limited to stream reaches where the expected flood discharge is greater than 800 cfs for the 10-percent flood (1 chance in 10 of being equal or exceeded in any given year) under conditions expected to prevail during the period of analysis.

- Potential associated functions should be incrementally justified.

Economic Criteria

- Benefits and costs should be expressed in comparable terms as completely as possible. Evaluation of alternatives should be based on the same price level, same interest rate, and the same project/economic life.

- Alternatives considered in detail should be "justified" in the same sense that total beneficial effects are equal to or exceed the total adverse effect associated with the objectives.

- Project benefits should be based on analysis of conditions without and subsequently with a project, using methodology contained in "Principles and Guidelines" and Corps of Engineers regulations.

Environmental Criteria

- Detrimental environmental effects should be avoided where possible--justifiable mitigation for unavoidable effects should be included. The priority for locating justifiable mitigation should be lands acquired for the other project features; however, the least costly mitigation shown by incremental analysis, despite location, will be the preferred choice.

- Adverse effects on National Register eligible historical, archeological, and architectural resources should be avoided where possible. Preservation and mitigation measures will be developed in consultation with the Nevada SHPO.

Socioeconomic Criteria

- Consideration should be given to the safety, health, and social well-being of the affected community.

- Displacement of residents should be minimized to the extent practical.

- Effects of local income, employment, business and industrial activity, population distribution, and desirable community growth should be considered.

- Plans should be workable within the constraints of present and potential governmental structure, function, relationships, and associations in the study area.

Tributary Streams

Even though there is a significant threat from local cloudburst flooding from southside tributary streams, none of

them have peak flows great enough to warrant consideration for individual Federal projects. Corps criteria contained in Engineering Regulation 1165-2-21, dated 30 October 1980, limits Corps flood control authority to the point where the flood discharge of a stream or waterway within an urban area is greater than 800 cfs for the 10 percent flood (1 chance in 10 of being equaled or exceeded in any given year) under conditions expected to prevail during the period of analysis. This regulation is commonly referred to as the "800 cfs rule." Neither the northside nor the southside tributaries meet these criteria. However, Southside Wash, Panorama Wash, and Metzler Wash produce flows that can be trapped behind the existing levee on the south bank of the Humboldt River. As mentioned, the levee can also fail due to ponding on the landside. Accordingly, the southside tributary streams were considered only for their ability to influence or aggravate the flood problem caused by a project that would resolve failure and flooding of the south levee from the Humboldt River.

FLOOD CONTROL MANAGEMENT MEASURES

Various measures were identified and initially considered to meet the planning objectives for flood control and in recognition of associated problems and needs. Following is a summary of each:

Nonstructural Measures

The purpose of nonstructural measures is to reduce flood damages rather than to control floodwaters. Nonstructural measures may include such measures as flood proofing, zoning/flood insurance, temporary and permanent evacuation, and elevating or flood proofing structures.

Flood Proofing. - Flood proofing includes elevating structures above the base flood elevation and constructing floodwalls to protect individual or small groups of structures. Also, because the average value of the structures within the flood plain is low, raising the structures is economically infeasible. Flood proofing would not provide the protection required on the Humboldt River.

Zoning/Flood Insurance. - Zoning includes flood plain regulations which restrict developments in floodway fringe areas and preclude structural developments in designated floodways. Private landowners are given the option to purchase flood insurance to insure existing developments against financial losses associated with flooding. Zoning and flood insurance are options for local governmental implementation, but are not viable Federal flood control options because no National Economic Development (NED) benefits are generated.

The flood plain areas on the Humboldt River in Elko are generally developed, and land for new development is limited. Zoning would not provide the desired protection to the existing structures. The city of Elko has, however, implemented the Federal Flood Insurance program established by the FEMA.

Temporary Evacuation. - A monitoring and warning system could be used to alert those within the flood plain of imminent flood threat and to evacuate potentially affected areas. Because the river stage increases gradually with snowmelt, residents along the Humboldt River in Elko could be warned of potential snowmelt flooding in time to evacuate, but permanent buildings would still be subject to flooding. Temporary evacuation would not contribute to the level of protection desired.

Permanent Evacuation. - Lands and developments within the flood plain subject to serious flooding could be purchased. However, this measure would be difficult to implement because the flood plain in Elko is substantially developed, and relocation cost would be extensive. Furthermore, the city of Elko is unlikely to agree to such relocations due to the socioeconomic impacts.

Summary. - Nonstructural measures would not provide the required protection to flood prone areas on the south side of the Humboldt River. In addition, there would be little likelihood that such measures could be implemented.

Multipurpose Reservoirs

Storage in multiple-purpose reservoirs can be used for flood control as well as water supply, recreation, etc. Corps studies in 1976 and before identified potential reservoir sites for storage of floodflows and prevention of flood damages at Devils Gate Lake and Hylton Lake, both upstream of Elko. The reservoirs were not found economically viable, and no local sponsor was identified. Currently, there is no known local support for multiple-purpose storage. Accordingly, this measure was not considered further.

Flood Detention Storage

Flood detention storage differs from reservoir storage in that no permanent pool or water conservation would take place. The sole purpose of a detention storage facility is to temporarily detain enough excess floodwater to limit downstream flow to the existing channel capacity. Detention storage on the Humboldt River for reduction of flood peaks and damages would not be economically viable due to the large volume of storage required.

Channel Improvement

The flow-carrying capacity of constricted stream reaches could be increased by removing vegetation, debris, and sediment; enlarging the channel; and replacing bridges with culverts.

Under Project Lifesaver, the Humboldt River channel through the city of Elko was relocated; removing additional material within the channel could cause headcutting. New bridges have been constructed in the reach of the Humboldt River within Elko over both the river and the railroad tracks. The cost of replacement or modification would be prohibitive. The existing levees on both banks of the Humboldt would limit channel improvement to lowering the thalweg through the problem reach, possibly causing environmental problems associated with headcutting both upstream and downstream of the improvement reach. Accordingly, the measure to modify the channel within the existing levees was eliminated due to prior improvements and likely adverse environmental impacts of any future modifications.

Levees/Floodwalls

Levees and/or floodwalls along developed stream reaches would contain floodflows. Improvement or replacement of levees on the south bank of the Humboldt River warrants further consideration.

For the north bank of the Humboldt River, the levee and berm with the two railroad lines have protection to above the 100-year event. Any modification could encroach on existing bridges, and the cost would be prohibitive. Accordingly, the levee modification measure was eliminated from further study at this time for the north bank of the Humboldt.

Conduits

A conduit or culvert could be used in place of a channel to convey floodflows. A conduit large enough to convey Humboldt River flows the length of the developed area would be costly and environmentally unsound.

SUMMARY

Table 8 shows a summary of the potential flood control management measures and whether they were retained or deleted from further development at this time.

TABLE 8

FLOOD CONTROL MANAGEMENT MEASURES RETAINED AND DELETED

Measure	Status
Nonstructural	Deleted - low potential for implementation
Multipurpose Reservoir	Deleted - likely high cost
Flood Detention Storage - Humboldt River	Deleted - likely high cost
Channel Improvements - Humboldt River	Deleted - low potential for implementation
Levees/Floodwalls - Humboldt River	Retained - high potential for implementation on south side
Conduits - Humboldt River	Deleted - likely high cost and low potential for implementation

RECREATION MANAGEMENT MEASURES

This measure includes the incorporation of recreation trails along levees and streams and the purchase of open areas, where available, to provide recreation opportunities.

The two railroad tracks and the soundwall preclude use of the north bank Humboldt River for a parkway. The south bank does not have enough unused land for a parkway, but one could be developed on top of the levee. The tributary streams are developed within the flood damage areas, precluding a parkway.

MEASURES CONSIDERED IN DETAIL

A levee on the south bank of the Humboldt River warranted further consideration for development into an alternative. Improving and extending the existing levee was the most likely solution to the flood problem.

MEASURES FOR INTERIOR DRAINAGE

As previously outlined, the tributary streams that drain behind the south Humboldt River levee do not meet the Corps 800 cfs criteria. Accordingly, measures to reduce flood damages from the drainage were not pursued in the plan formulation process. However, increasing the existing levee height and strength could result in damages due to increasing the duration of ponding behind the levee. The following four measures to address this problem were considered.

Channel Improvement

The natural Panorama Wash tributary has been replaced with a 48-inch culvert downstream of Lamoille Highway. Streets and homes have been constructed over the natural drainage. As a result, channel improvement, levees, or floodwalls are not viable. The terrain would also prohibit channeling the stream to an adjacent drainage. On Metzler Wash, flows could be routed around developed areas in an improved channel.

Detention Storage

It is estimated that, for a 100-year event, 15 acre-feet would need to be removed from the ponded area behind the Humboldt levee to offset potential induced flooding. Possible sites for detention storage were investigated on both Panorama and Metzler Washes. The site on Panorama Wash appears to be the best location. A detention basin with 15 acre-feet of storage capacity indicates the first cost would be $230,000. Although some flood control benefits would result from reduced overland flooding on Panorama Wash, the benefits would not be sufficient to justify the increased construction cost of a detention basin over the measure using conduits.

Conduits

Conduits could be placed through the levee to reduce the ponding volume. It is estimated that five culverts would be needed to reduce the induced ponding. The estimated first cost of the culverts was $80,000.

Levees and Floodwalls

Levees or floodwalls could be used on Metzler Wash to confine floodflows to the natural stream, thus preventing flows from being trapped behind the Humboldt River levees. However, this measure could require channel improvements and conduits near Lamoille Highway. On Panorama Wash, the natural channel has been filled in, and low flow is now conveyed in a 48-inch pipe culvert. There has been significant development in the historic channel location. Accordingly, levees to control flooding or the

induced damages from the improved Humboldt River would not be feasible. This measure was deleted from further study.

Summary

Culverts would be the most effective and least costly method to deal with the interior drainage and prevent increased ponding. Accordingly, culverts were used in plan formulation to address flood problems from the Humboldt River.

DEVELOPMENT OF ALTERNATIVE PLANS

Plan formulation for this study consisted of developing and evaluating two alternative plans--no action and a plan to provide a 100-year level of protection.

The period of analysis for this study is considered to be 50 years, from 1998 to 2048. The period includes the time required for the project to be implemented. Construction of a project could potentially begin in 1997 (base year) and take 1 year to complete. The actual base year will depend on congressional authorization, funding, and various other factors.

No-Action Alternative

Under this alternative, no action would be taken by the Federal Government to reduce flood problems and conditions in the study area. No action means that the without-project condition would continue.

- The existing levee on the south bank of the Humboldt River would be expected to fail at about the 33-year event, or at a flow of 7,200 cubic feet per second.

- The Southside Detention Basin constructed by the SCS is currently not maintained.

- Because of the uncertainty of emergency flood fighting efforts during major flood events, potential flood fight measures are not considered part of the without-project conditions.

- Neither the State nor local agencies have any current plans to construct flood control measures on the southside tributary streams.

Levee, Recreation Trail, and Culvert Alternative

Feature. - This alternative includes upgrading and extending the levee on the south bank downstream of the 12th Street bridge to provide 100-year protection. (See Plate 8.) Total length of the levee would be 5,430 feet, including 3,860 feet of enlarged

levee, 750 feet of rebuilt levee, and 820 feet of new levee. The new levee would be constructed downstream to tie into the existing levee. The crown of the levee would be 12 feet wide, and side slopes would be 1 vertical on 3 horizontal. The average height would range from 9 feet between the 12th Street bridge downstream to the 5th Street bridge to approximately 5 feet downstream of the 5th Street bridge. The new tieback levee would average 2 to 3 feet in height. This alternative would require 8 acres. The levee would be designed for 3 feet of freeboard; 100 feet upstream and downstream of the bridges, the freeboard would be 4 feet. For the reconstructed levee just downstream of 12th Street, the riprap that was previously installed will be removed and replaced. Toe protection is provided by a built-up toe section at the base of the riprap. Adjacent to the section of levee that is to be enlarged, the channel is very wide, overbank velocities are low, levees are set back 100 to 200 feet from the channel, and no bank protection is required. The levee slope would be protected from erosion by seeding with a selected mixture of native grasses.

A paved trail about 4,600 feet long and 10 feet wide would be constructed on the crown of the enlarged levee. The trail would be asphalt with a stabilized aggregate base. A gravel parking lot for five cars would be provided near the upstream terminus at the 12th Street bridge. Access to the trail would be provided at 12th Street, the pedestrian bridge, and the downstream end of the enlarged levee.

With improvement to the levee, induced damages could result from the additional ponding time of the tributary floodflows behind the levee. Once the levee is raised and/or reconstructed, it will not fail from interior ponding as before. As mentioned, a flood runoff estimated at 15 acre-feet would need to be removed from the ponded area behind the levee to prevent additional damages up to the design level of 100 years. This alternative would use additional culverts through the levee to reduce ponding. Three 36-inch culverts with drop inlets would be constructed just downstream of the 12th Street bridge. An additional 36-inch culvert would be placed at the low point in the overbank area between the pedestrian bridge and the 5th Street bridge. An additional 24-inch culvert would be placed through the tieback levee downstream of the 5th Street bridge. The culverts would have flap gates on the riverside to prevent backflow during floods on the Humboldt River. The flood events on the Humboldt and the tributary streams are from independent events. Accordingly, the culverts would drain the area behind the levee during cloudbursts. A feature of this alternative would also include replanting about 1 acre of riparian vegetation, especially willows (see below).

Impacts and Mitigation. - The environmental impacts would include disruption of existing vegetation during construction. Loss of existing willows would be an adverse impact. Because the Humboldt River through Elko is often without water during the late summer and early fall, impacts to fisheries could be reduced to less than significant levels if construction is scheduled during that time. Standard construction measures would be employed for avoiding or minimizing soil disturbance outside the immediate construction area.

As mentioned, 1 acre of riparian vegetation would be planted to offset a similar loss due to construction.

Since no cultural resources will be affected by the project, no mitigation is required. However, if any cultural resources are discovered during construction of the project, work in the immediate area should stop until a Corps archeologist evaluates the situation. Specifically, 35 CFR 800.11 requires the Corps to satisfy the requirements of Section 106 concerning these additional cultural resources.

Accomplishments. - This alternative would provide a 100-year level of flood protection from the Humboldt River for the area on the south bank from the 12th Street bridge downstream to Bullion Road bridge. The trail would provide recreation opportunities.

Costs and Benefits. - On the basis of October 1992 price levels, the total estimated first cost of this alternative is $1,230,000. Of this, about $970,000 is for levees and related construction, $140,000 for the recreation trail, $100,000 for culverts, and $20,000 for mitigating potential cultural and environmental damages. This project would be completed in one construction season. Average annual costs are estimated at $120,000, including $116,000 for interest and amortization and $4,000 for operation and maintenance. Annual costs are based on an 8-1/2 percent interest rate and a 50-year amortization period. The annual cost of operation and maintenance is included in the estimated costs.

Estimated average annual flood control and recreation benefits amount to $201,000. The resulting benefit-cost ratio is 1.7 to 1.

Table 9 summarizes the costs and benefits of the alternative for the levee, recreation trail, and interior drainage culverts. Some flooding from local runoff would still be generated, primarily from summer cloudbursts on the tributary streams.

TABLE 9

SUMMARY OF COSTS AND BENEFITS [1]

Item	Levee, Trail, and Culvert Alternative
First Cost [2]	
Total Lands	660,000
Levees	310,000
Culverts	80,000
Recreation Trail	60,000
Environmental Mitigation	10,000
Cultural Resources	10,000
E & D, S & A	100,000
Total	1,230,000
Interest During Construction	110,000
Total Investment	1,340,000
Average Annual Cost [3] [4]	
Interest and Amortization	116,000
O & M	4,000
Total	120,000
Annual Benefits [4]	
Flood Control	
Flood Damage Reduction	155,000
Flood Insurance Administration	13,000
Recreation	34,000
Total	202,000
Net Annual Benefits	82,000
Benefit-Cost Ratio	1.7

[1] October 1992 price levels.
[2] Rounded to nearest $10,000.
[3] 50-year project life.
[4] 8-1/2 percent interest rate.

BENEFIT EVALUATION OF ALTERNATIVES

Flood Control Benefits

Inundation reduction benefits were estimated by evaluating damages for the levee, trail, and culvert alternative. This alternative would provide a 100-year level of protection from flooding on the Humboldt River to areas south of the river in Elko. Table 10 compares the without- and with-project damages and resulting benefits by major damage category.

TABLE 10

LEVEE, TRAIL, AND CULVERT ALTERNATIVE
WITHOUT-/WITH-PROJECT DAMAGES [1]
($1,000)

Category	Without-Project Damages	Levee With 100-Year Protection	
		Damages	Benefits
Residential	58.6	15.0	43.6
Multi-Residential	2.4	0.6	1.8
Mobile Home	95.1	46.3	48.8
Commercial	17.1	4.6	12.5
Public	20.2	5.5	14.7
Sheds	1.1	0.4	0.7
Emergency Costs	28.4	8.8	19.6
Road Damages	3.2	0.9	2.3
Auto Damages	17.5	6.7	10.8
Subtotal	243.6	88.8	154.8
Flood Insurance Administration Costs			13.0
Total	243.6	88.8	167.8

[1] Oct 1992 prices, 1998-2048 at 8-1/2 percent interest rate.

Flood Insurance Administration costs are the reduction in costs associated with the administration of the NFIP. The cost of servicing flood insurance policies includes the average cost per policy (including agents' commissions) and the costs of servicing and adjusting claims. The NFIP operating cost is currently $77 per policy. The Flood Insurance Administration (FIA) cost benefits were $26,000 for the Humboldt River south. The levee, trail, and culvert alternative would only remove about half of the south side flood plain from the 100-year flood plain. Accordingly, the FIA cost benefit would be $13,000 per year.

A detailed description of the economic analysis for flood control is included in Attachment A.

Recreation Benefits

The alternative includes approximately 0.87 mile of levee with a pedestrian/bicycle trail. The standards for trail use for this type of trail are 90 people per mile of trail per day plus 10 percent. For this project, visits are estimated at 87 per day, or 8,900 per year. At a dollar value of $3.81 (multiplied by 8,900 visits per year) average annual recreation benefits over the 50-year life of the project are about $33,900. A complete analysis is presented in the Economic Analysis, Attachment A.

CHAPTER V - FEASIBILITY-PHASE STUDIES

STUDY SCOPE

On the basis of the identified flood and related problems and needs in Elko and likely alternatives to resolve these problems, it appears that the scope of a project would appropriately conform to provisions of the Corps Continuing Authorities Program. Section 205 of the Flood Control Act of 1948 (Public Law 80-858), as amended, is specifically designed to expediently implement needed projects having a total Federal construction cost less than $5 million. Accordingly, it appears appropriate to pursue accomplishment of the feasibility phase under provisions of Section 205. Under this program, the feasibility phase would culminate in a Detailed Project Report (DPR). The Headquarters, U.S. Army Corps of Engineers (HQUSACE) has the authority to approve a DPR. Following approval, plans and specification would be prepared and a local cost-sharing agreement (LCA) for construction would be executed. HQUSACE then would allocate appropriate funds for construction under the Continuing Authorities Program.

NON-FEDERAL SPONSOR'S VIEWS

Current Federal cost-sharing laws require that a non-Federal local sponsor share 50 percent of the feasibility-phase study costs. Representatives of the City of Elko, the potential non-Federal sponsor, have informally indicated an interest in participating in the feasibility phase of the study. The non-Federal sponsor is expected by November 1992 to provide a letter stating the intent to participate in the study and that the Feasibility Cost-Sharing Agreement (FCSA--see next paragraph) is acceptable.

REQUIRED STUDIES

Attachment B includes a draft FCSA. A draft Initial Project Management Plan (IPMP), which becomes part of the FCSA, is included as Attachment C. The IPMP describes the scope, cost, and schedule for the feasibility study. The FCSA is between the Department of the Army (represented by the Sacramento District Engineer) and the non-Federal Sponsor (the City of Elko) and identifies the equal sharing of cost for the feasibility study.

STUDY MANAGEMENT

The non-Federal sponsor will participate in study management. In order to manage a cost-shared study, an Executive Committee and a Study Management Team will be formed. This management structure will be formalized in the FCSA.

The Executive Committee will include the District Engineer (or his designee) and his chief planner. The sponsor, along with his primary technical advisor, will be an equal partner with the Corps representatives on the Committee. The District Engineer and his counterpart from the City of Elko will co-chair the Committee.

The Study Management Team will include representatives from the Corps, the non-Federal sponsor, and other interests (FWS, Nevada DFG, etc.) as appropriate. This team will ensure appropriate scope of the studies, guide in their accomplishment, and participate in selection of potential solutions. The team will be directly involved in establishing mutual roles and in focusing on the critical issues. Corps representatives will include the study manager and the Acting Chief, Colorado/Great Basin Branch. The team will recommend to an Executive Committee the tasks to be conducted and extent of planning and evaluation to be carried out in the feasibility phase. The team will also report on the results of studies to the Committee and recommend alternative courses of action for project implementation.

The Executive Committee will participate in Issue Resolution Conferences (IRCs) and ratify decisions made by the Study Management Team. The Committee is also responsible for resolving any disputes that may arise during the study. The Committee will agree on the solutions and study direction, which may include termination. At least one IRC will be held prior to the public distribution of the draft feasibility report to ensure that all issues are resolved before the final report is submitted to higher authority. Additional IRC's will be held, as required, throughout the study to resolve any problems that may arise.

The Corps study manager will be required to perform both the general supervision of personnel involved in the study and the management of the study itself. He will ensure that funds are allocated to the proper organizational elements and that appropriate analyses are conducted to develop the information needed to evaluate the resource problems in the study area. He will also direct the flow of technical information between the Corps and the local sponsor in order to accomplish the work in an efficient and timely manner.

FINANCIAL ANALYSIS

Feasibility Phase

The feasibility phase will be cost shared 50 percent Federal and 50 percent non-Federal. Half of the non-Federal share can be in in-kind-service. The City of Elko will be the non-Federal sponsor.

Construction Phase

The cost of constructing the project will be shared in accordance with the Water Resources Development Act of 1986. During construction of a project, the non-Federal sponsor is required to provide upfront in cash 5 percent of the total flood control cost, and all lands, easements, rights-of-way, and relocations. If the total of these is less than 25 percent of the total project cost, the sponsor will pay the difference during construction. However, the total non-Federal cost will not exceed 50 percent of the total project cost. Costs of separable recreation facilities would be shared 50-50.

CHAPTER VI - CONCLUSIONS AND RECOMMENDATIONS

CONCLUSIONS

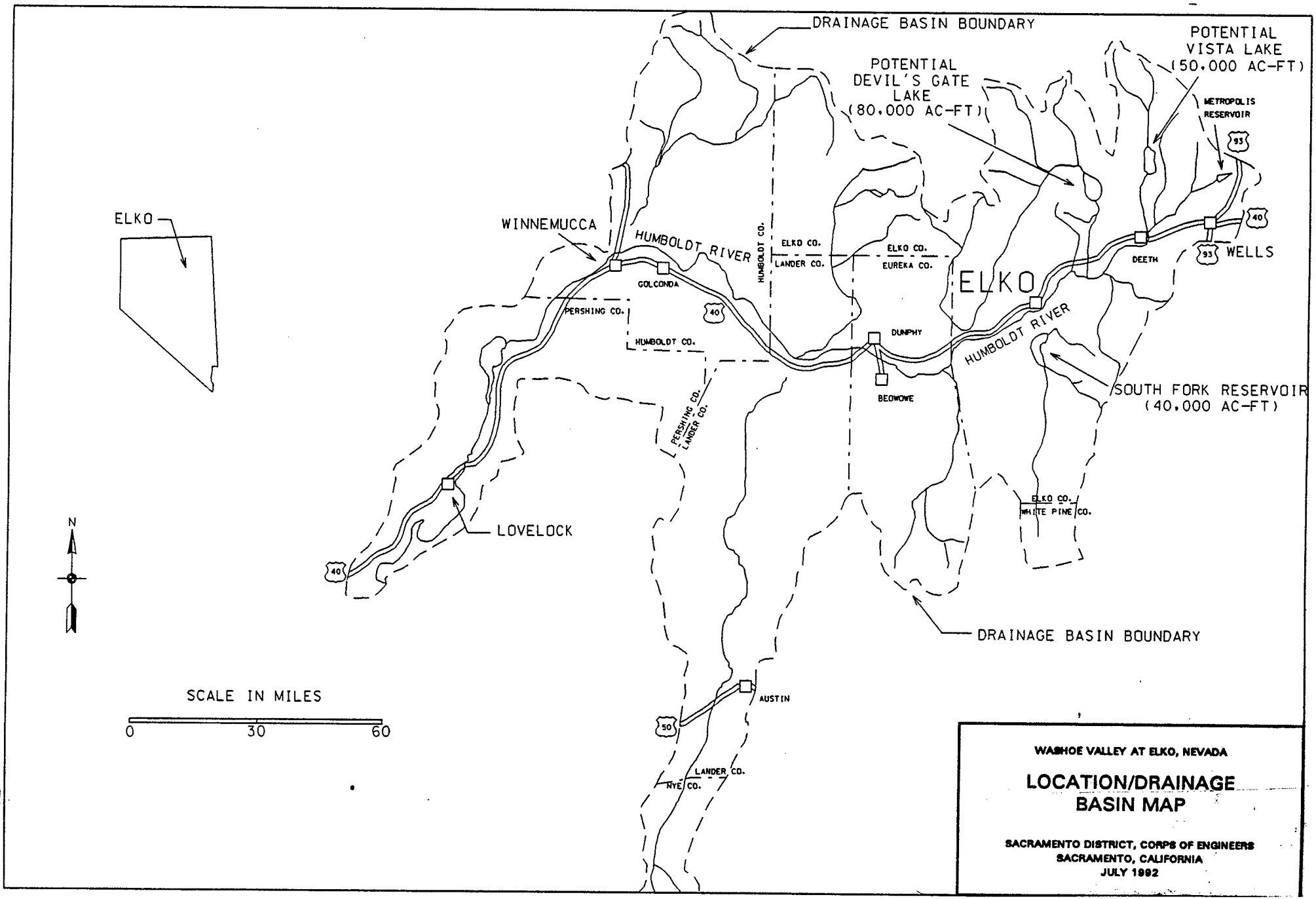
Major conclusions of the reconnaissance study are as follows:

- The south (left) bank of the Humboldt River in the City of Elko has only flood protection to a 33-year event.
- The critical location for levee failure is just downstream of the 12th Street bridge.
- Much of the development south of the Humboldt River is subject to damages from flooding from both snowmelt and general rain events on the Humboldt River as well as local (interior) runoff flooding.
- The north (right) bank of the Humboldt River in the city of Elko has in excess of a 100-year level of protection.
- There is a need for increased recreation development in the Elko area.
- The average annual equivalent flood damages along the Humboldt River and southside tributaries in Elko are estimated at $346,600.
- The potential for loss of life from flooding on the Humboldt River is fairly low due to a relatively long warning time.
- An alternative to provide at least a 100-year level of flood protection to areas on the south side of the Humboldt appears to be economically feasible.
- Although areas to the south of the Humboldt River are subject to flooding from cloudburst events on local tributaries, the peak flows are not sufficient to satisfy Corps criteria for potential Federal involvement. Even so, the flooding can be substantial, and local interests are encouraged to pursue solutions to this drainage problem.
- Feasibility phase studies would cost about $330,000, with one-half to be paid by the non-Federal sponsor (city of Elko).
- The feasibility phase of study and subsequent actions should be accomplished under provisions in Section 205 of the Flood Control Act of 1948.

RECOMMENDATION

It is recommended that this reconnaissance report serve as both a response to the congressional resolution authorizing this study and as a Section 205 reconnaissance report, thus allowing the feasibility study to proceed under the Continuing Authorities Program. This recommendation is subject to agreement by the City of Elko to act as the required non-Federal sponsor for the feasibility study as specified in the FCSA.

Laurence R. Sadoff
Colonel, Corps of Engineers
District Engineer

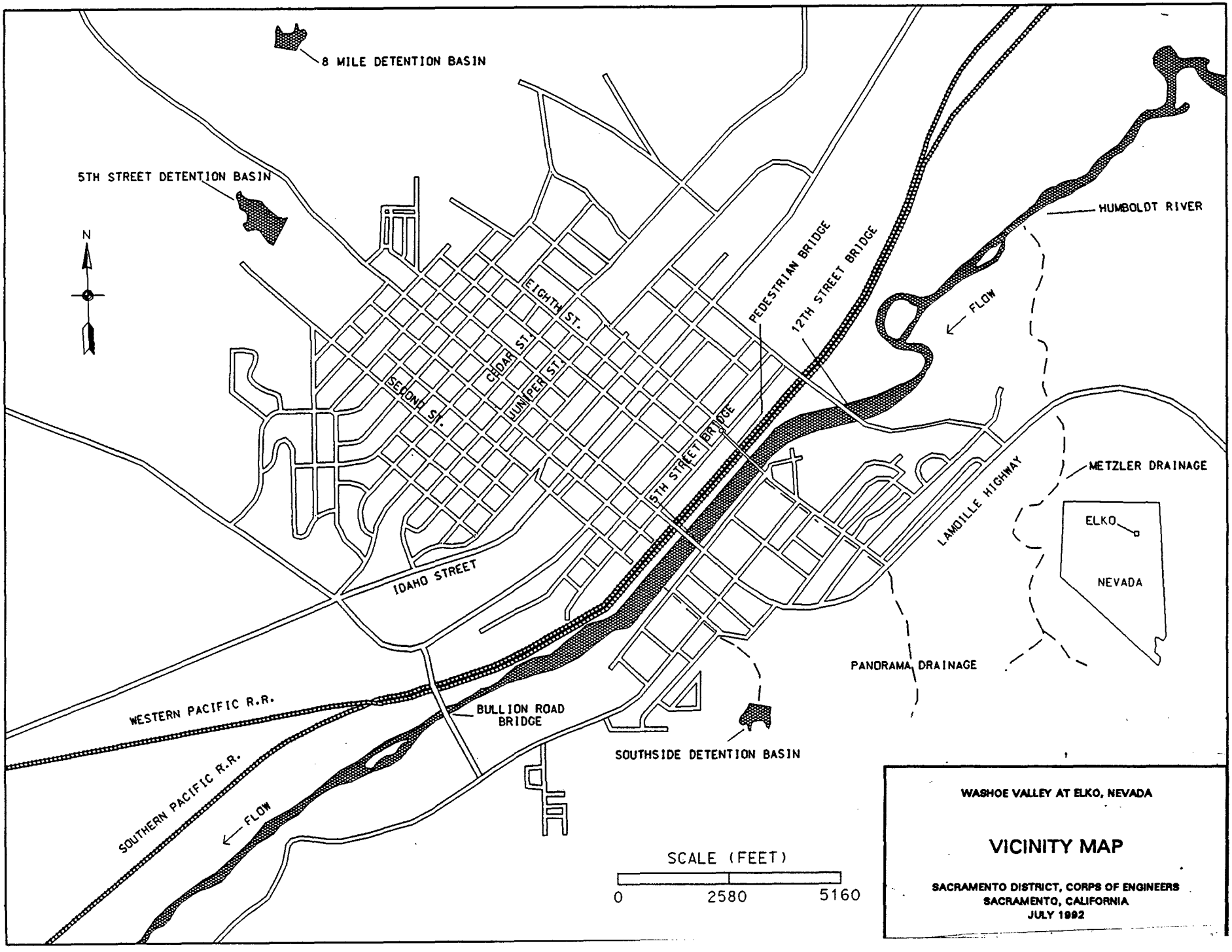


WASHOE VALLEY AT ELKO, NEVADA

LOCATION/DRAINAGE BASIN MAP

SACRAMENTO DISTRICT, CORPS OF ENGINEERS
SACRAMENTO, CALIFORNIA
JULY 1992

PLATE 1



WASHOE VALLEY AT ELKO, NEVADA

VICINITY MAP

SACRAMENTO DISTRICT, CORPS OF ENGINEERS
SACRAMENTO, CALIFORNIA
JULY 1992

PLATE 2

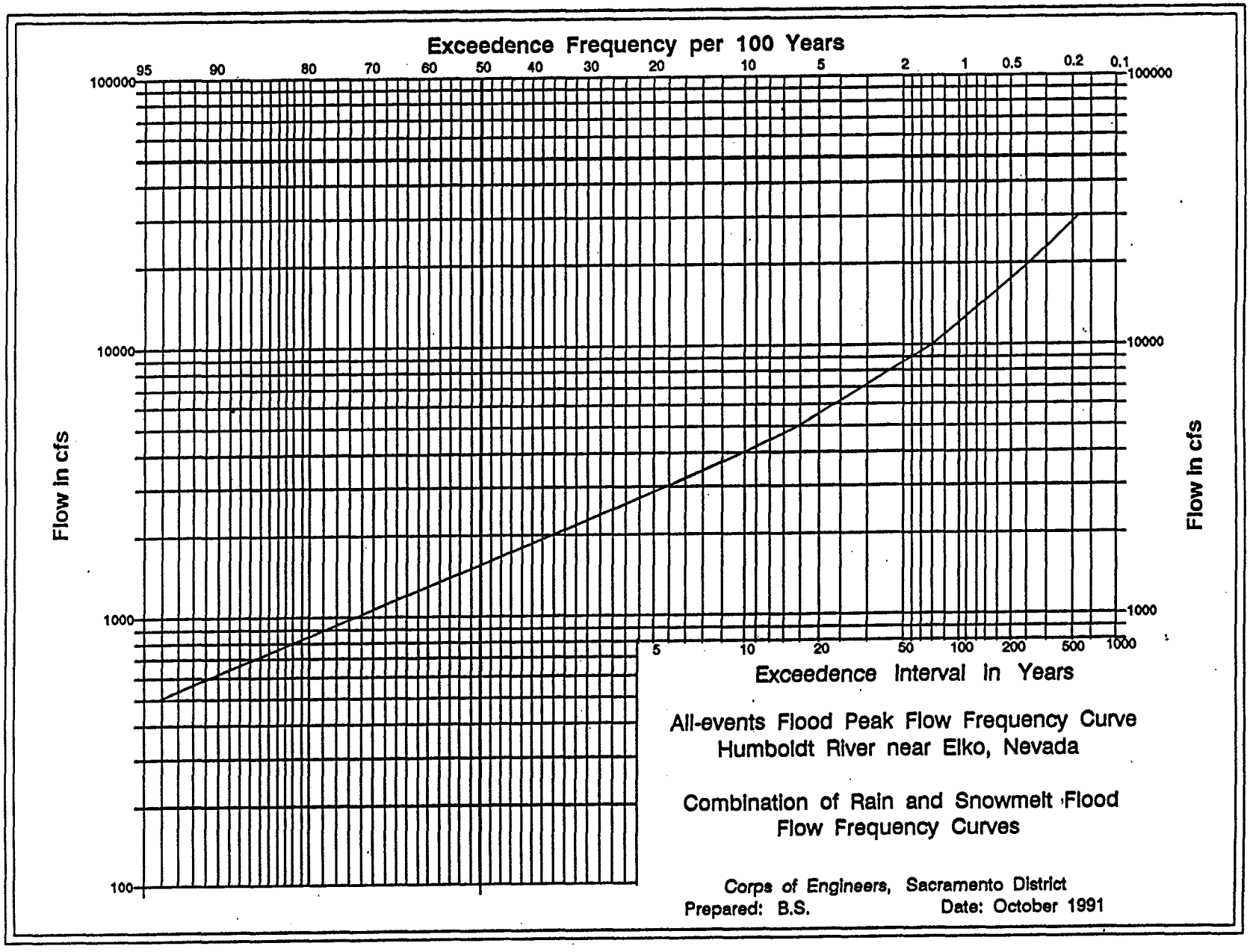

Exceedence Frequency per 100 Years
95 90 80 70 60 50 40 30 20 10 5 2 1 0.5 0.2 0.1
100000
10000
1000
100
Flow in cfs
Flow in cfs
5 10 20 50 100 200 500 1000
Exceedence Interval in Years
All-events Flood Peak Flow Frequency Curve
Humboldt River near Elko, Nevada
Combination of Rain and Snowmelt Flood
Flow Frequency Curves
Corps of Engineers, Sacramento District
Prepared: B.S. Date: October 1991

PLATE 3

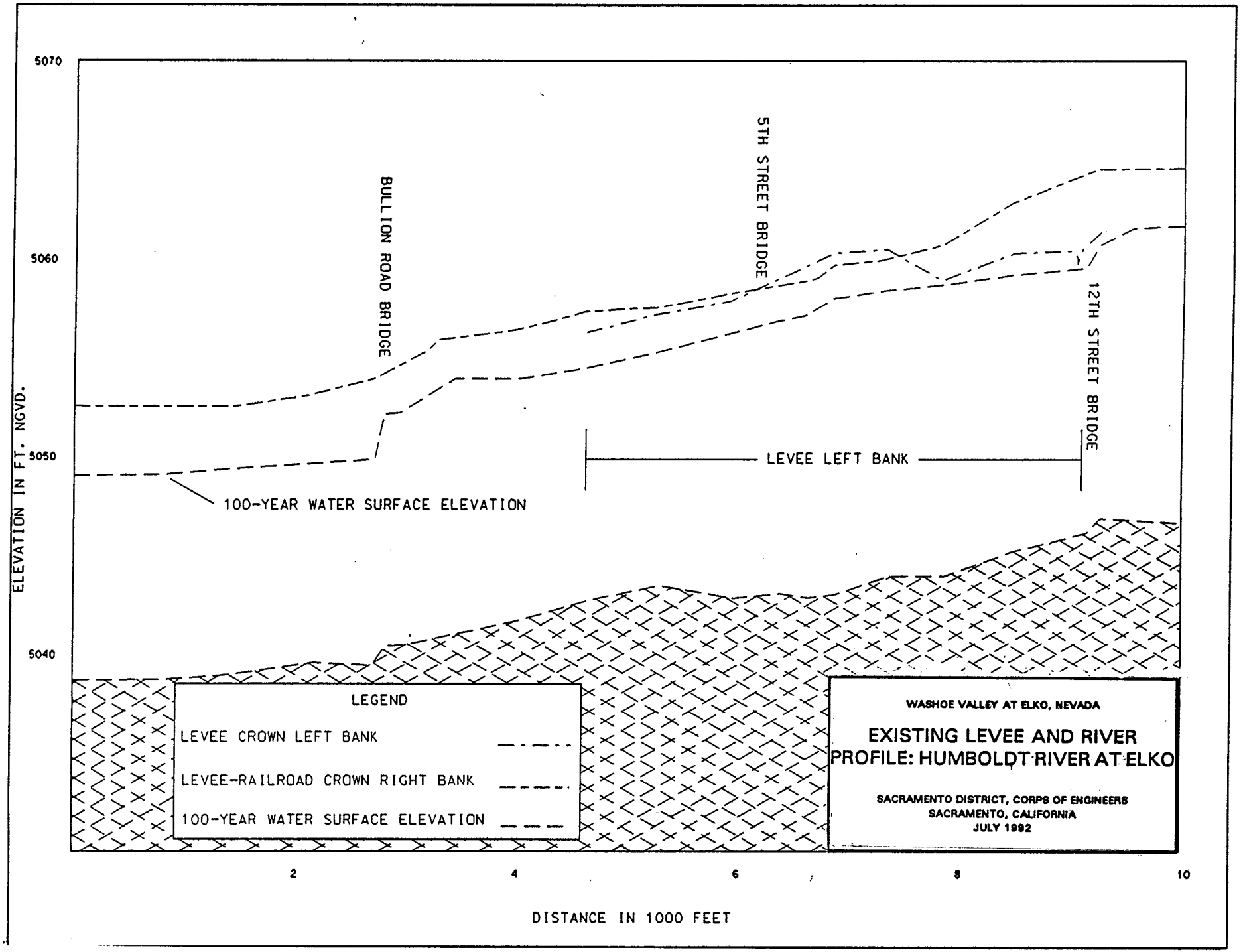
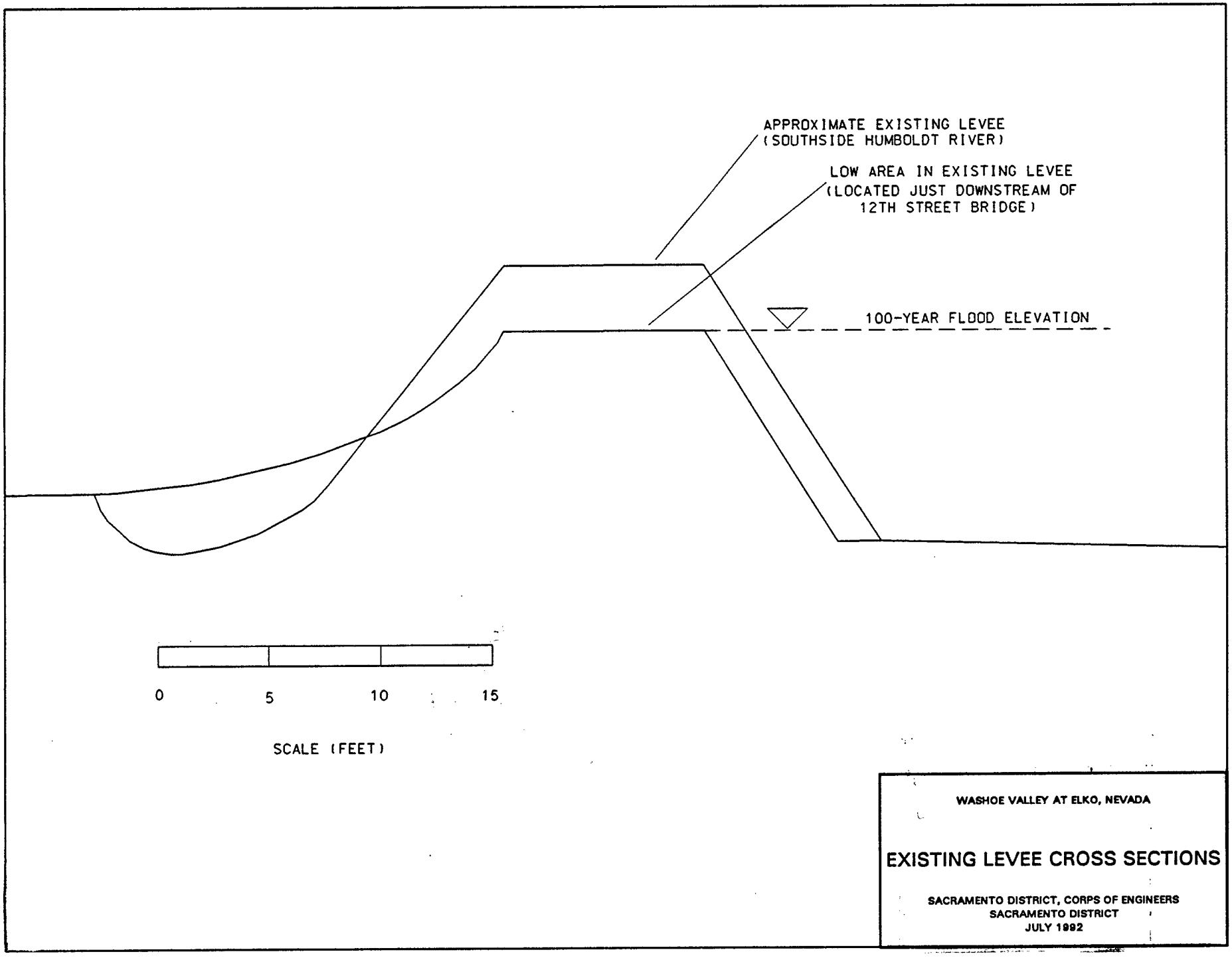

5070
5060
5050
5040
ELEVATION IN FT. NGVD.
BULLION ROAD BRIDGE
5TH STREET BRIDGE
12TH STREET BRIDGE
LEVEE LEFT BANK
100-YEAR WATER SURFACE ELEVATION
LEGEND
LEVEE CROWN LEFT BANK
LEVEE-RAILROAD CROWN RIGHT BANK
100-YEAR WATER SURFACE ELEVATION
2
4
6
8
10
DISTANCE IN 1000 FEET
WASHOE VALLEY AT ELKO, NEVADA
EXISTING LEVEE AND RIVER PROFILE: HUMBOLDT RIVER AT ELKO
SACRAMENTO DISTRICT, CORPS OF ENGINEERS
SACRAMENTO, CALIFORNIA
JULY 1992

PLATE 4

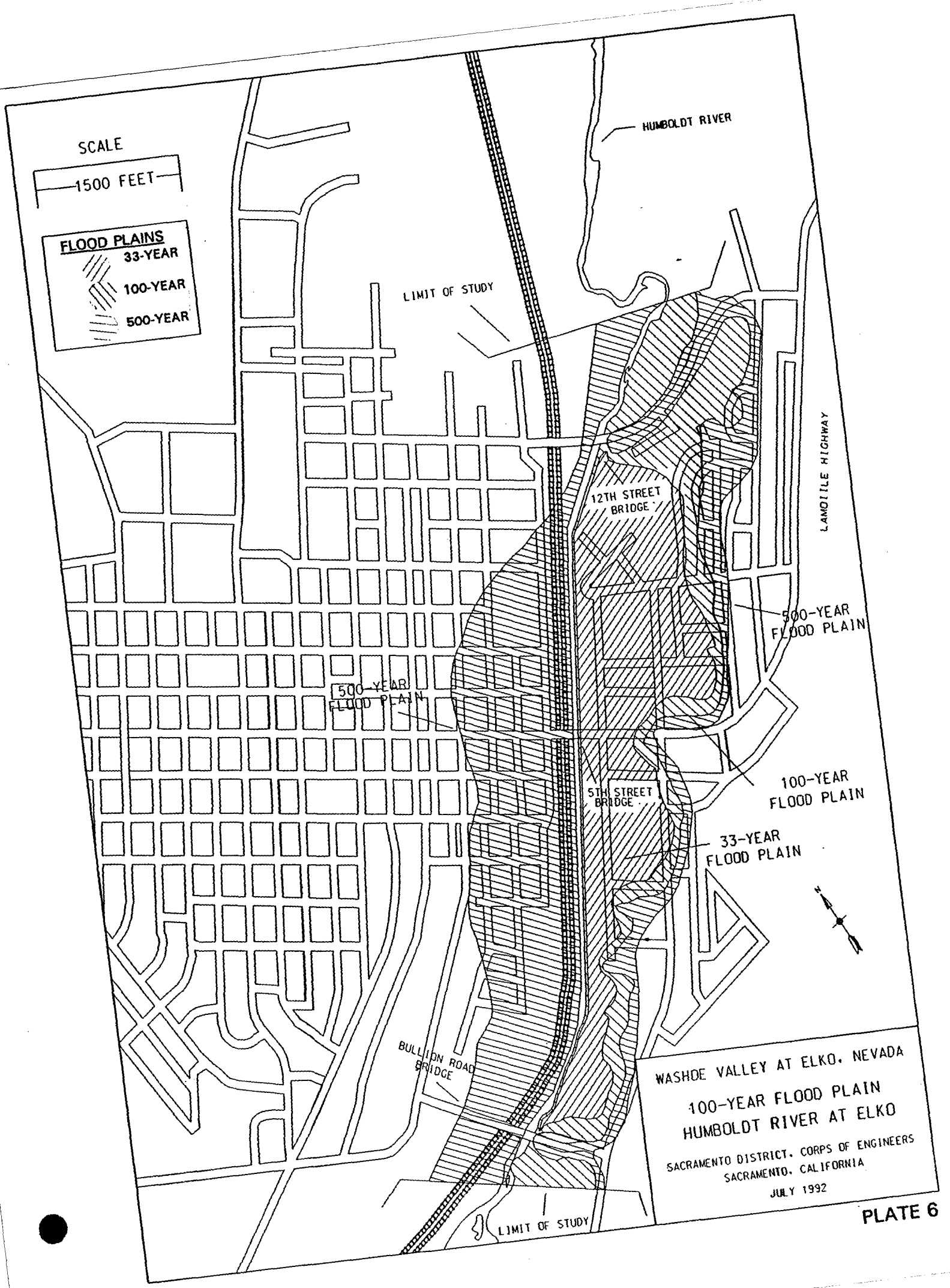


WASHOE VALLEY AT ELKO, NEVADA

EXISTING LEVEE CROSS SECTIONS

SACRAMENTO DISTRICT, CORPS OF ENGINEERS
SACRAMENTO DISTRICT
JULY 1992

PLATE 5

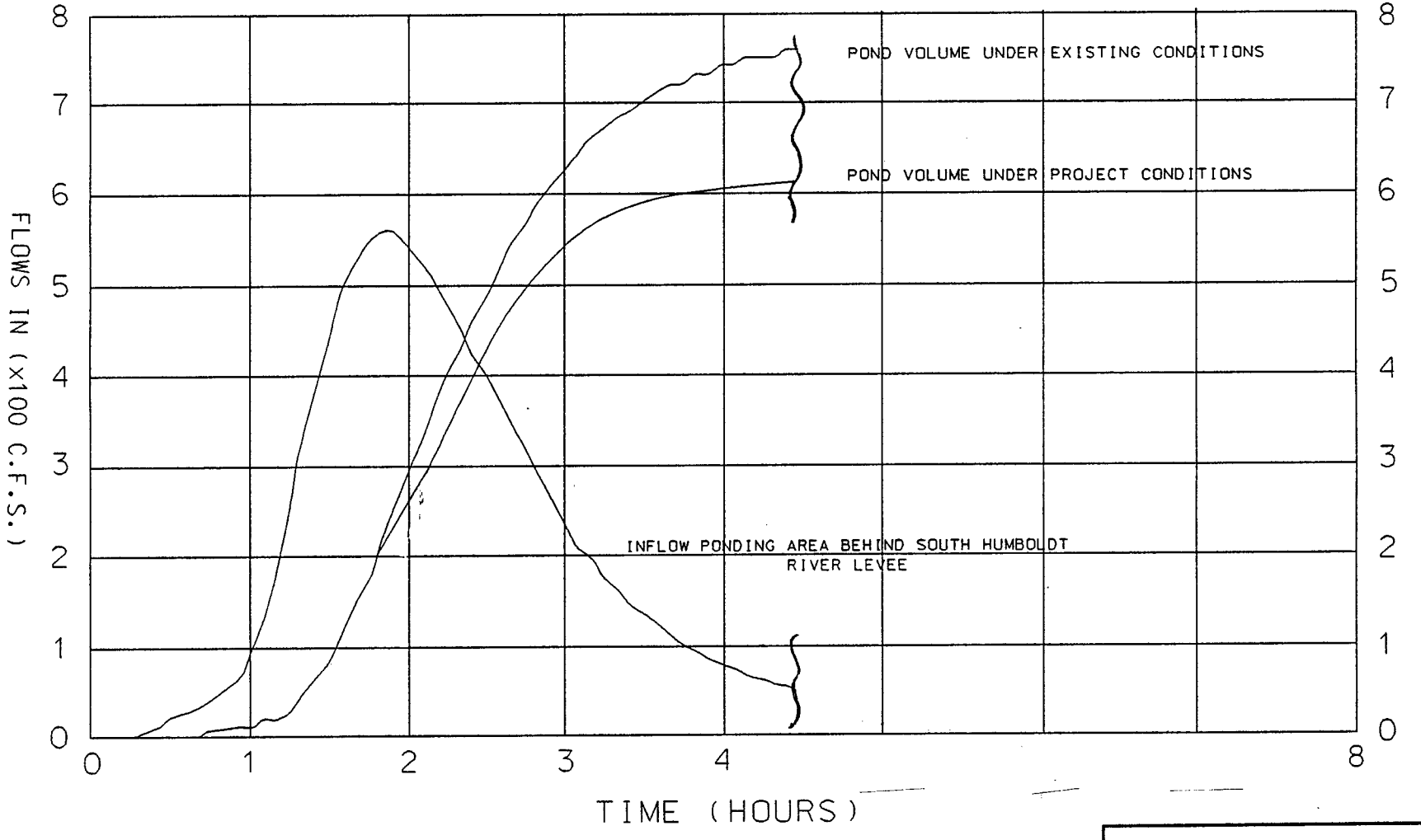


WASHOE VALLEY AT ELKO, NEVADA

100-YEAR FLOOD PLAIN
HUMBOLDT RIVER AT ELKO

SACRAMENTO DISTRICT, CORPS OF ENGINEERS
SACRAMENTO, CALIFORNIA
JULY 1992

PLATE 6



WASHOE VALLEY AT ELKO, NEVADA

100-YEAR XRATE MODEL TRIBUTARY STREAMS

SACRAMENTO DISTRICT, CORPS OF ENGINEERS
SACRAMENTO, CALIFORNIA
JULY 1992

PLATE 7

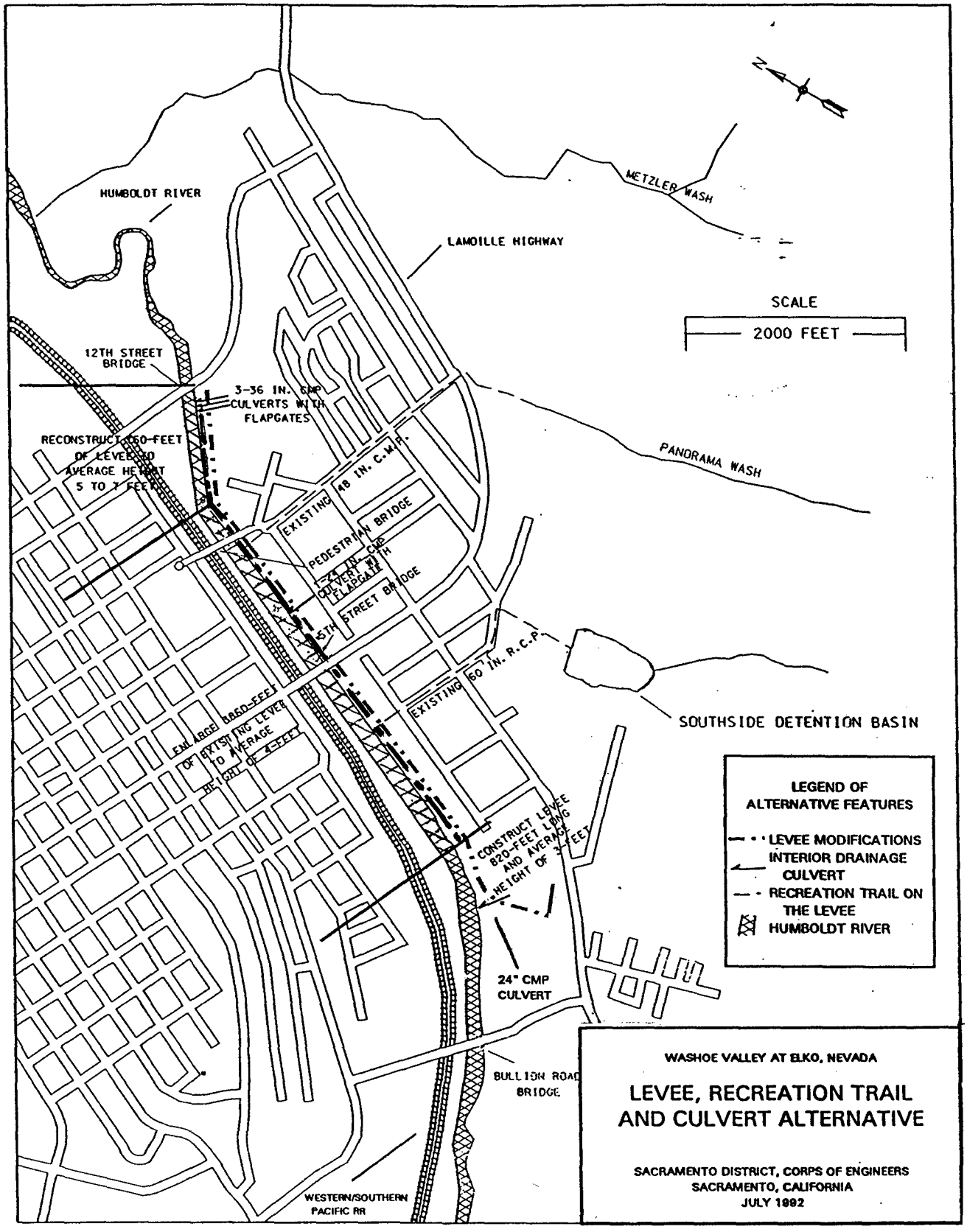

HUMBOLDT RIVER
METZLER WASH
LAMOILLE HIGHWAY
SCALE
2000 FEET
12TH STREET BRIDGE
3-36 IN. CMP CULVERTS WITH FLAPGATES
RECONSTRUCT 650-FEET OF LEVEE TO AVERAGE HEIGHT 5 TO 7 FEET
PANORAMA WASH
EXISTING 48 IN. C.M.P.
PEDESTRIAN BRIDGE
24 IN. CMP CULVERT WITH FLAPGATE
5TH STREET BRIDGE
EXISTING 60 IN. R.C.P.
SOUTHSIDE DETENTION BASIN
ENLARGE 6800-FEET OF EXISTING LEVEE TO AVERAGE HEIGHT OF 4-FEET
CONSTRUCT LEVEE 820-FEET LONG AND AVERAGE HEIGHT OF 3-FEET
LEGEND OF ALTERNATIVE FEATURES
LEVEE MODIFICATIONS
INTERIOR DRAINAGE CULVERT
RECREATION TRAIL ON THE LEVEE
HUMBOLDT RIVER
24" CMP CULVERT
BULLION ROAD BRIDGE
WESTERN/SOUTHERN PACIFIC RR
WASHOE VALLEY AT ELKO, NEVADA
LEVEE, RECREATION TRAIL AND CULVERT ALTERNATIVE
SACRAMENTO DISTRICT, CORPS OF ENGINEERS
SACRAMENTO, CALIFORNIA
JULY 1992

PLATE 8

Reconnaissance Report
Washoe Valley at Elko, Nevada

ENVIRONMENTAL EVALUATION

ENVIRONMENTAL EVALUATION

WASHOE VALLEY, ELKO, NEVADA

RECONNAISSANCE STUDY

FOR

FLOOD CONTROL

SEPTEMBER 1992

SACRAMENTO DISTRICT, CORPS OF ENGINEERS

Table of Contents

INTRODUCTION

The Corps of Engineers, Sacramento District is conducting a reconnaissance study of flood control alternatives in the Washoe Valley at Elko, Nevada. The purpose of the reconnaissance study is to determine the potential for Federal participation in the development and construction of flood control measures for the Humboldt River and tributary washes near Elko, Nevada. The study will identify the present level of flood protection and develop preliminary alternatives to address any additional need for flood protection.

Scope of Analysis. The Corps prepared this environmental evaluation to determine if any significant environmental impacts would result from the implementation of the alternative flood control measures. Should this evaluation determine there are significant impacts and the reconnaissance study proceed to the feasibility phase, further documentation for compliance with the National Environmental Policy Act (NEPA) will be required. The documentation may be an environmental assessment or an environmental impact statement.

Location. The Humboldt River basin is located in north central Nevada. The basin is irregular in shape and drains an area of about 16,700 square miles. The Humboldt River is the largest stream in Nevada. The river flows westward from its headwaters to the alkali flats of the Humboldt Sink near Lovelock, a total length of nearly 300 miles. Due to its meandering nature, the actual channel length of the Humboldt River is 600 miles. (See Figure 1.)

Near Elko, the river runs though a trough-like valley between the River Range to the northwest and the Elko Range to the southeast. The valley ranges from 7 to 9 miles in width and the lowest part of the basin lies near the base of the Elko Range. This study focuses on the reach of the Humboldt River through Elko.

Problems and Opportunities. Flooding is the primary water-related problem along the Humboldt River in Elko. Other problems and opportunities examined along with flood control in the reconnaissance study are natural resources and recreation improvements.

Three distinct events cause flooding in the Humboldt River basin: (1) winter rain on snow and/or low elevation snowmelt, (2) spring snowmelt with high elevation rain, and (3) summer cloudbursts. Cloudburst events do not coincide with the other two flood types involving the Humboldt River. This creates two distinct flood problems in Elko. The first problem stems from high flows in the Humboldt River resulting from the first two

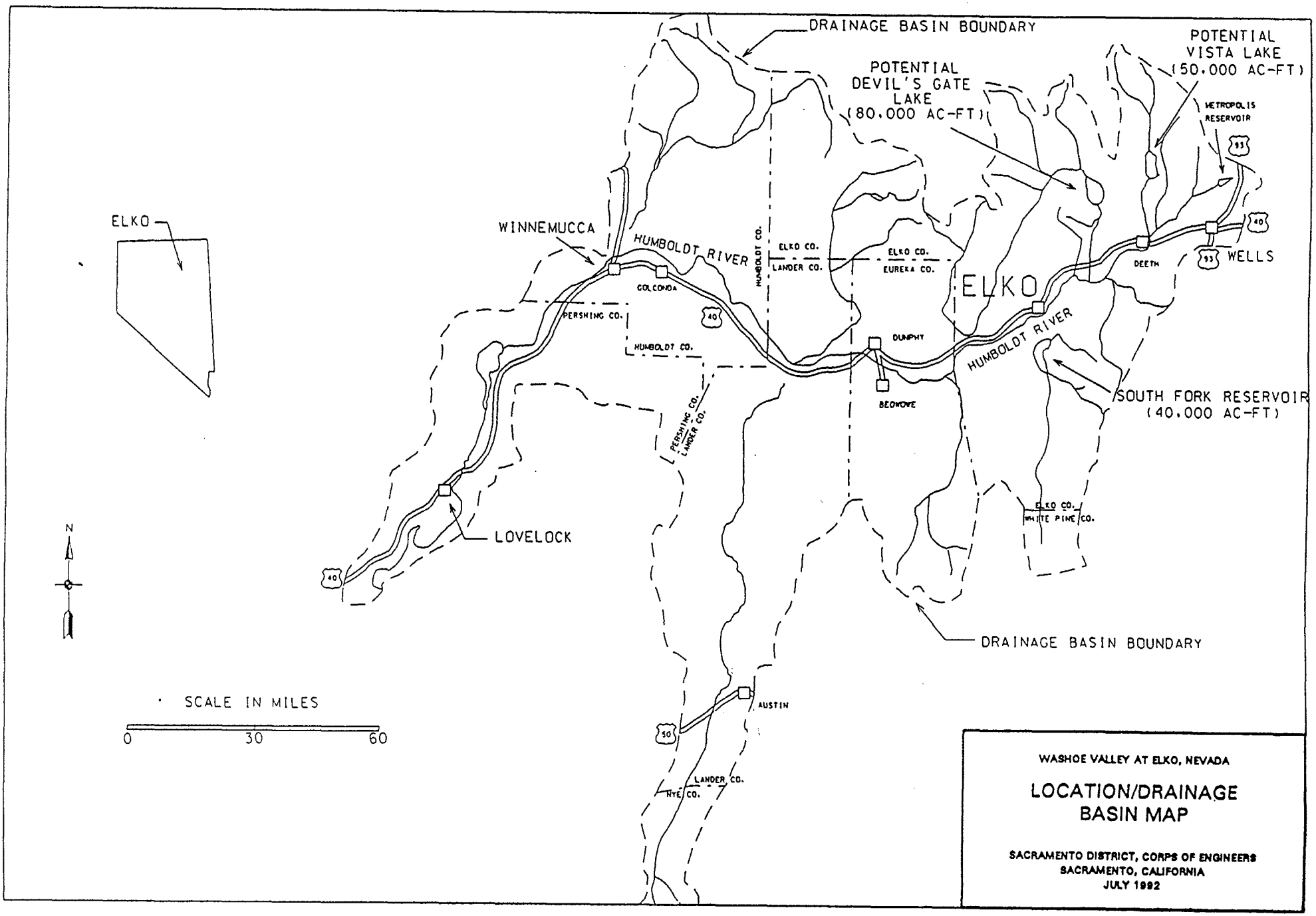

DRAINAGE BASIN BOUNDARY
POTENTIAL VISTA LAKE (50,000 AC-FT)
POTENTIAL DEVIL'S GATE LAKE (80,000 AC-FT)
METROPOLIS RESERVOIR
ELKO
WINNEMUCCA
HUMBOLDT RIVER
HUMBOLDT CO.
ELKO CO.
LANDER CO.
ELKO CO.
EUREKA CO.
ELKO
DEETH
WELLS
COLCONDA
PERSHING CO.
HUMBOLDT CO.
DUNPHY
HUMBOLDT RIVER
BEOWOVE
SOUTH FORK RESERVOIR (40,000 AC-FT)
PERSHING CO.
LANDER CO.
ELKO CO.
WHITE PINE CO.
LOVELOCK
DRAINAGE BASIN BOUNDARY
AUSTIN
LANDER CO.
NYE CO.
N
SCALE IN MILES
0
30
60
WASHOE VALLEY AT ELKO, NEVADA
LOCATION/DRAINAGE BASIN MAP
SACRAMENTO DISTRICT, CORPS OF ENGINEERS
SACRAMENTO, CALIFORNIA
JULY 1992

FIGURE 1.2

events. The second is created by cloudbursts that send floodflows down the washes into southern Elko; these flows then pond behind the existing south levee. Any alterations to the existing south levee could increase this second flood problem. Therefore, both problems were investigated together.

Each type of flood listed above has occurred in the Elko area in recent years. In February 1986, the Elko area experienced a winter rain on snowmelt flood with peak flows recorded of 6,410 cubic feet per second (cfs). In May 1984, a large snowmelt flood led to peak flows of 5,790 cfs at Elko. The latest cloudburst flood, in September 1990, happened when Panorama Wash flows went out-of-bank and damaged homes in south Elko.

Local officials identified the lack of vegetation along the Humboldt River through Elko for wildlife enhancement and esthetic improvement as another problem for investigation and requested assistance. Native riparian vegetation existed in this reach before the construction of the Elko Railroad Relocation Project (Project Lifesaver). This demonstration project realigned portions of the Southern Pacific and Western Pacific rail lines from downtown Elko to along the north bank of the Humboldt River. In addition, Project Lifesaver straightened the reach of the Humboldt River through Elko and stripped vegetation from its banks. The U.S. Department of Transportation, the Federal Highway Administration, the State of Nevada, and the City of Elko jointly constructed the project.

The City of Elko also requested that recreation improvements be considered and that any recreation features in the plan be consistent with the City's conceptual Humboldt Area Recreation Plan (HARP). No details of specific facilities proposed in this plan are available at this time.

Existing flood control features. As part of Project Lifesaver, a 4,610-foot levee was constructed along the south bank of the Humboldt River from the 12th Street bridge to just east of Bullion Street bridge in the early 1980's. This levee has an 800-foot section west of the 12th Street bridge that the Corps considers substandard. A soundwall along the north bank between the city and the railroad tracks from the 12th Street bridge to just past the 5th Street bridge was also constructed under Project Lifesaver but was not designed for flood protection.

Southside Wash has a detention structure, constructed by the Soil Conservation Service, designed to control the 100-year cloudburst event. No detention basins are located on either Panorama Wash or Metzler Wash. (See Figure 2.)

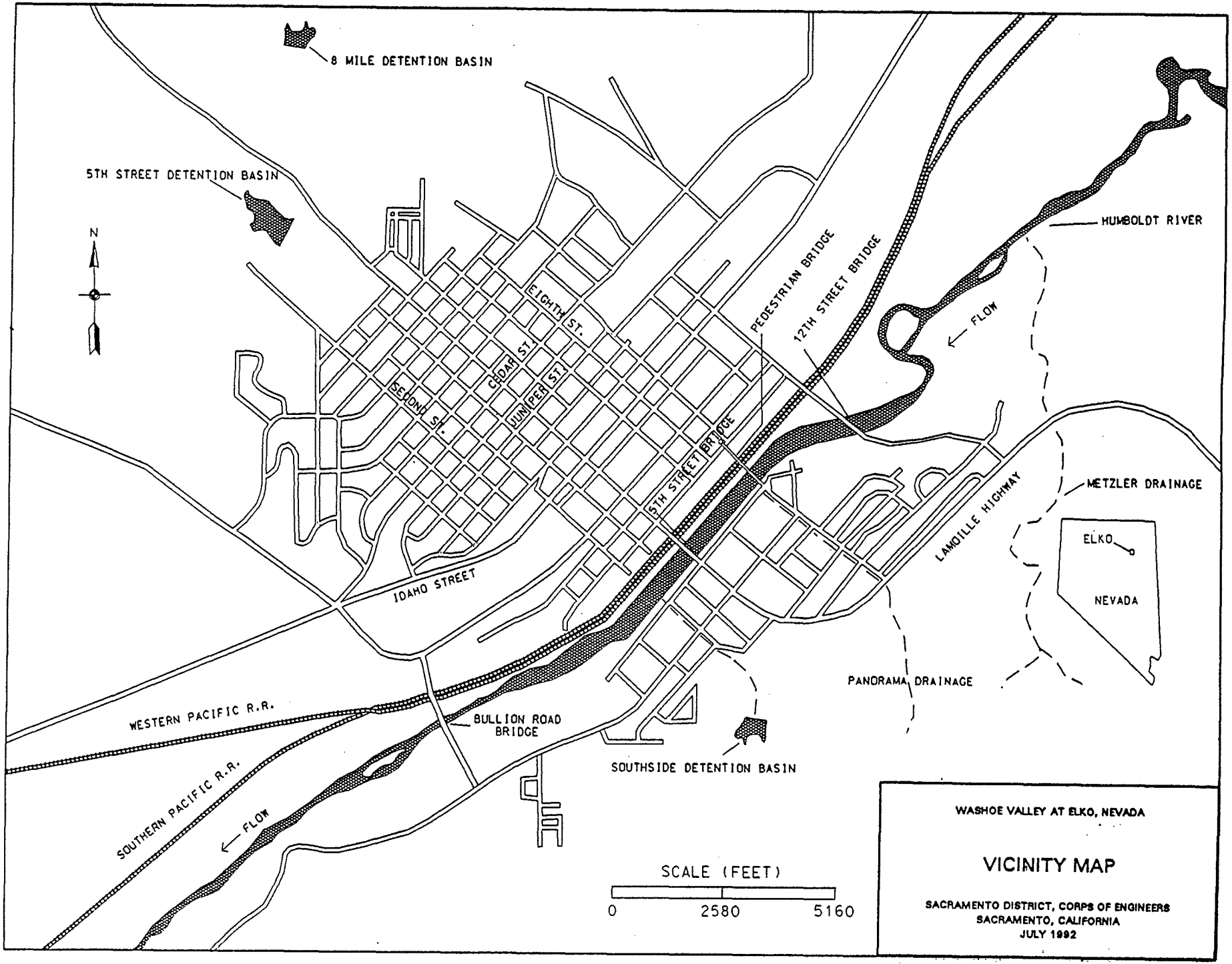

8 MILE DETENTION BASIN
5TH STREET DETENTION BASIN
N
HUMBOLDT RIVER
FLOW
PEDESTRIAN BRIDGE
12TH STREET BRIDGE
EIGHTH ST.
CEDAR ST.
JUNIPER ST.
SECOND ST.
5TH STREET BRIDGE
METZLER DRAINAGE
LAMOILLE HIGHWAY
ELKO
NEVADA
IDAHO STREET
PANORAMA DRAINAGE
WESTERN PACIFIC R.R.
BULLION ROAD BRIDGE
SOUTHERN PACIFIC R.R.
FLOW
SOUTHSIDE DETENTION BASIN
SCALE (FEET)
0
2580
5160
WASHOE VALLEY AT ELKO, NEVADA
VICINITY MAP
SACRAMENTO DISTRICT, CORPS OF ENGINEERS
SACRAMENTO, CALIFORNIA
JULY 1992

FIGURE 2

ALTERNATIVES

This section describes the various alternatives considered by this study to address the existing flood problems on the Humboldt River and the project-induced flooding in south Elko.

Plans Eliminated from Further Study. Restoration measures to address local concerns about degradation of vegetation along the Humboldt were considered in the early stages of this study. These measures addressed restoration in areas both upstream of the 12th Street bridge and downstream of the project reach. The Corps determined that restoration of environmental degradation resulting from Project Lifesaver was outside its authority and eliminated the restoration alternative from further study. However, the City of Elko or other agencies may wish to pursue this measure. Information developed for this alternative can be found in the Fish and Wildlife Service's Planning Aid Letter (attachment 2).

No Action Alternative. This alternative consists of the continued maintenance of the current levee system with no additional flood controls on the tributary washes of Southside Wash, Panorama Wash and Metzler Wash. This alternative is used as the basis for establishing without-project conditions.

Levee, Recreation Trail, and Culvert Alternative. This alternative consists of rebuilding a 750-foot section of levee, upgrading the remaining 3,860 feet of existing levee, and constructing 820 feet of new tieback levee. This work would result in a total of 5,430 feet of levee on the south bank of the Humboldt River downstream of the 12th Street bridge to provide 100-year flood protection. The Corps would raise the existing levee 2 to 5 feet at various locations, depending on levee condition. Previously installed riprap would be removed and replaced. The levee would be designed to provide 3 feet of freeboard; 100 feet upstream and downstream of the bridges, freeboard would be 4 feet.

Improvements to the existing south levee of the Humboldt River would increase the time of flooding behind the levee in the south portion of Elko. To lessen this time would require that ponding behind the south levee be reduced by 15 acre-feet. Three 36-inch pipe culverts would convey flows through the levee to the Humboldt River. Additional culverts would be placed at the low point in the overbank area between the pedestrian bridge and the 5th Street bridge and through the tieback levee downstream of the 5th Street bridge. Flap gates would cover the culverts on the riverside to prevent backflows during flood events on the Humboldt River.

In addition, the plan includes a recreation component consistent with Elko's conceptual HARP. A 10-foot-wide multi-use

trail would be constructed along the levee crown. This trail would be constructed of asphalt with a stabilized aggregate base to allow bicycle and pedestrian use. Access to the trail would be from both ends and at the 9th Street pedestrian bridge. A gravel parking lot for five cars would be provided near the upstream terminus at the 12th Street bridge. (See Figure 3.)

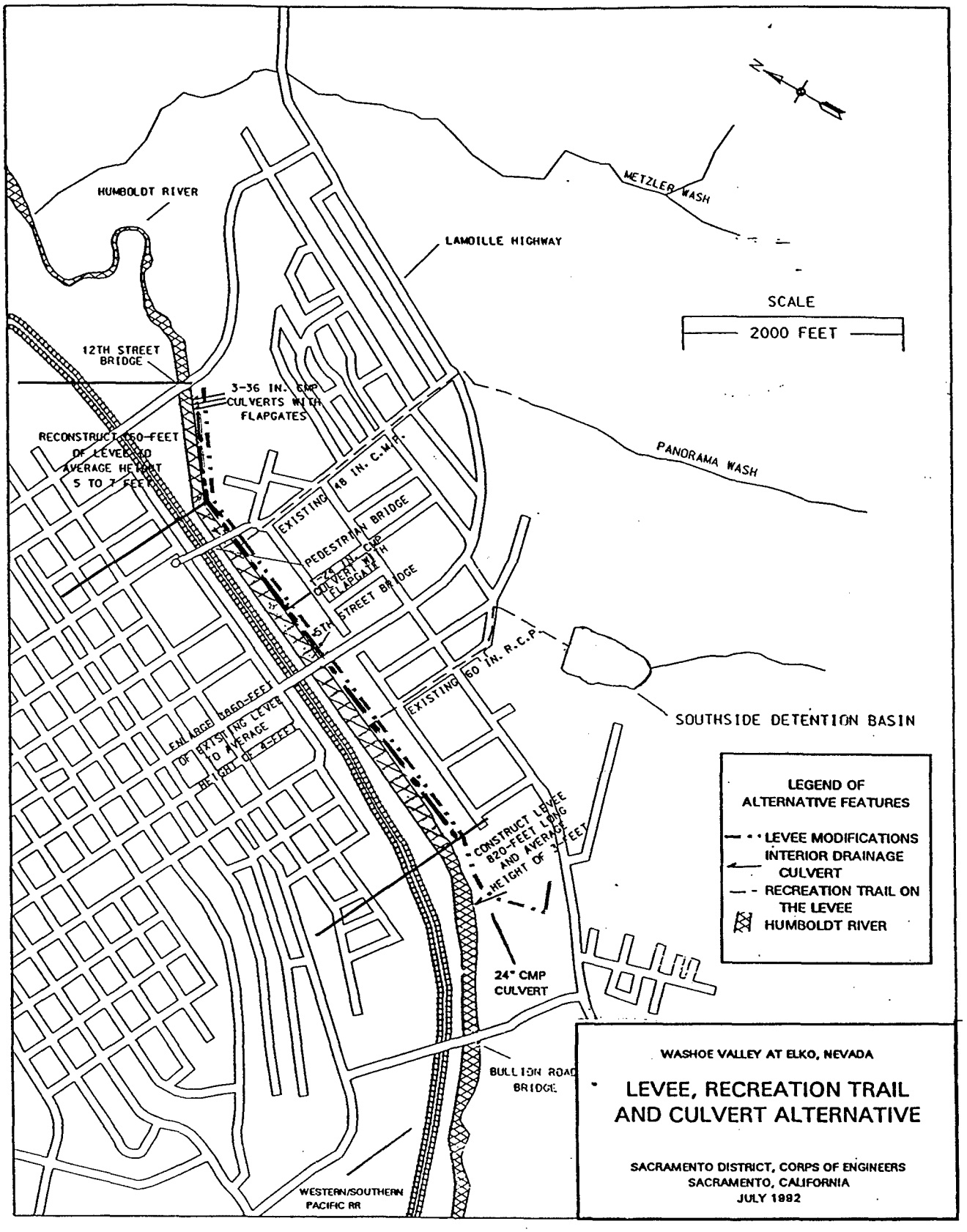

HUMBOLDT RIVER
METZLER WASH
LAMOILLE HIGHWAY
SCALE
2000 FEET
12TH STREET BRIDGE
3-36 IN. CMP CULVERTS WITH FLAPGATES
RECONSTRUCT 1660-FEET OF LEVEE TO AVERAGE HEIGHT 5 TO 7 FEET
48 IN. C.M.P.
EXISTING PEDESTRIAN BRIDGE
24 IN. CMP CULVERT WITH FLAPGATE
5TH STREET BRIDGE
PANORAMA WASH
60 IN. R.C.P.
EXISTING
SOUTHSIDE DETENTION BASIN
ENLARGE 8860-FEET OF EXISTING LEVEE TO AVERAGE HEIGHT OF 4-FEET
CONSTRUCT LEVEE 820-FEET LONG AND AVERAGE HEIGHT OF 7-FEET
24" CMP CULVERT
BULLION ROAD BRIDGE
WESTERN/SOUTHERN PACIFIC RR
LEGEND OF ALTERNATIVE FEATURES
LEVEE MODIFICATIONS
INTERIOR DRAINAGE CULVERT
RECREATION TRAIL ON THE LEVEE
HUMBOLDT RIVER
WASHOE VALLEY AT ELKO, NEVADA
LEVEE, RECREATION TRAIL AND CULVERT ALTERNATIVE
SACRAMENTO DISTRICT, CORPS OF ENGINEERS
SACRAMENTO, CALIFORNIA
JULY 1992

FIGURE 3

EXISTING CONDITIONS

Climate. The climate in the Humboldt River basin is arid to semiarid, although fairly high amounts of precipitation fall in the high mountain area. The average annual precipitation in Elko is 9.2 inches and total annual snowfall is 38.8 inches. The normal high temperature averages 99°F and the average low is 14°F (Elko Chamber of Commerce, 1991; Nevada State Demographer's Office 1992).

Geology. The study area along the Humboldt River consists of Quaternary alluvium and older alluvium. An outcrop of the Humboldt Formation occurs within a mobile home park beneath an overlying tuff unit. A small outcrop of the Indian Well Formation, consisting of welded tuff, tuffaceous sediments, and vitric ash, occurs in a road cut near State Highway 46. The Elko Formation is the oldest sedimentary unit in western Elko County containing volcanic material. This formation contains oil shale, claystone, siltstone, some limestone and tuff and Eocene in age. There is a restricted outcrop of the Late Paleozoic Diamond Peak Formation on the southern and eastern boundaries of the study area (Coats, 1987; Steward, 1980; Firby, 1992).

Soils. The Soil Conservation Service classifies the soils in the bed and along the banks of the Humboldt River as Devilsgait-Woofus-Devilsgait gravelly substratum association. These soils are a combination of silt loam, silty clay loam, and silt loam gravelly substratum. This soil association is good for wetland plants, fairly suitable for wild herbaceous plants and nonirrigated shrubs, and fair for shallow water areas (Soil Conservation Service, 1985).

Air Quality. A combination of industrial and urban activities provide the largest source of air pollution for the Elko area. The revival of the mining industry and rapid urban growth within Elko in recent years have contributed to air quality problems in the area. The amount of construction in the area combined with high winds creates serious air quality problems at times throughout the year (Hoelscher pers. comm., 1992).

Air quality information from 1990 indicates that Elko exceeded primary Federal standards twice and secondary standards three times. Federal standards allow one exceedence per year. In addition, Elko exceeded State air quality standards for total suspended particulates five times in 1990. Unlike Federal standards, Nevada standards allow no exceedence (Freeman, 1991). Draft information from 1991 shows that Elko did not exceed national or State air quality standards for total suspended particulates for the year. This may be due, in part, to Elko's adoption of a new method of measurement in September 1991 (Hoelscher pers. comm., 1992).

Air quality impacts associated with the alternatives under study are expected to be short-term construction impacts. No long-term impacts to air quality are anticipated.

Water Quality. Categories of water quality concern in the Humboldt River are Total Suspended Solids (TSS), Total Dissolved Solids (TDS), Total Phosphorus, and nitrate concentrations. Alkali conditions in the Great Basin also influence water quality in the Humboldt River. The presence of these alkali salts increases fivefold in the river from Elko to the Toulon Drain near Lovelock. The State of Nevada considers alkali a major source of concern.

Sediment transport has long been a water quality problem for the Humboldt. This pollutant has adversely affected agriculture and contributed to the suspended load and dissolved solids content of the river system.

The City of Elko discharged treated effluent into the Humboldt from its treatment plant until 1987. As a result, the reach of the Humboldt through Elko to the Palisade monitoring station regularly exceeded the standard for total phosphates. Since the discontinuation of discharge in 1987, total phosphates have not exceeded the standard. In spite of this improvement in river water quality, the State in 1990 classified the reach near the Palisade station as water quality limited for Total Phosphorus and Suspended Solids (State of Nevada, 1992; Chilton, 1975).

Potential impacts to water quality from construction of the alternatives are expected to be of short duration. Levee work along the south bank of the Humboldt may introduce some sediments into the river at the time of construction, but this would be a temporary impact. This impact could further be reduced or eliminated if timing of construction coincided with the period that the Humboldt River is dry.

Socioeconomic Conditions. The City of Elko has experienced a large increase in population in the last 10 years. According to the 1980 census, 8,758 people lived in Elko. An estimated 23,000 lived in Elko in 1990, an increase of 162 percent. Elko County has also increased in population, growing from 17,269 in 1980 to about 36,200 in 1990.

Nearly 3,000 single-family homes exist in Elko. Apartments and multi-family dwellings number 1,136, and an equal number of mobile homes exist in Elko. There are 513 commercial buildings within the city limits.

Elko's economy reflects that of the overall State economy, with service and manufacturing industries providing the bulk of the employment opportunities. However, extensive mining and

ranching activities also boost Elko's economy (Elko Chamber of Commerce, 1991; City of Elko, 1987; Department of Taxation).

Rare, Threatened, and Endangered Species. The U.S. Fish and Wildlife Service provided a letter on November 5, 1991, stating that no endangered, threatened, or candidate species existed in the study area. (see attachment 1.) However, FWS updated that information in its May 1992 Planning Aid Letter, which identified one endangered species and several candidate species in the project vicinity. (see attachment 2.) Observation of a bald eagle in January 1992 at the Hot Hole (Sulfur White Springs) west of the Bullion Street bridge resulted in this new listing. The endangered bald eagle is known to follow waterfowl on their winter migration routes. The Nevada Department of Wildlife considers the flood plain of the Humboldt River a wintering area for the bald eagle.

The Fish and Wildlife Service also believes three candidate species frequent the Elko vicinity. The first candidate species, the white-faced ibis, breeds primarily in the Great Basin states. Although this species was once common in the marshes of the Ruby Lakes National Wildlife Refuge, 30 miles from Elko, no reported colonies exist on or near the flood plain. However, the ibis is still frequently seen on flood-irrigated agricultural lands east of Elko. The second candidate species is the loggerhead shrike. The shrike may be present during the summer in desert scrubs, piñon-juniper woodlands, and mountain mahogany stands. Limited information is available on the final candidate species, the spotted frog. FWS reports the frog is known to occur in the Humboldt River drainage, and several sightings have been made on tributaries north of Elko. However, no sightings of the spotted frog have been reported in the immediate Elko area (FWS, 1992).

Consultation with the Nevada Department of Wildlife revealed the State of Nevada has no State listing of endangered species, but instead defers to the Federal list (Bradley pers. comm., 1992a).

During feasibility studies, the Corps will request a current list of threatened and endangered species from the FWS. The Corps would then prepare a biological assessment of endangered species affected by the project.

Recreation Resources. The City of Elko has four municipal parks located throughout the city. The central municipal park generates the major use, while the three smaller parks have limited use. The City of Elko has a conceptual recreation plan for the Humboldt River through Elko. Although specific details are unavailable at this time, the city envisions a multipurpose use of river frontage. Because no recreational facilities are along the Humboldt River now, the conceptual plan could provide

for parks, trails, and nature experiences along the reach from the 12th Street bridge to the Bullion Street bridge.

City officials estimate the city will need additional recreational facilities in the future as Elko continues to grow. The 1987 Master Plan Update forecast the need for another city park sometime after 1990. Before initiation of the reconnaissance study, local officials expressed to the Corps an interest in recreational facilities along the Humboldt (City of Elko, 1987; Klein, 1992).

VEGETATION

Existing Conditions. The reach of the Humboldt River through Elko contained riparian vegetation before construction of Project Lifesaver. Roughly half of the riverbank through Elko supported willow cover prior to the railroad relocation. Quality riparian vegetation in the area is presently minimal, although the Nevada Department of Wildlife recently observed some colonization of stream deposits and unstable banks by young willows. These stands occur in only one or two locations within the study area. Habitat type has converted from riparian to upland vegetation since the completion of Project Lifesaver. Dry site grasses, forbs, and upland shrubs now grow on the existing levee (Rawlings and Neel, 1989; Bradley, 1992b).

Adjacent to the study area, vegetation along the banks of the Humboldt River near Elko is largely agricultural, primarily harvested hay meadows. Agricultural activities removed much of the natural riparian vegetation from along the river and in the flood plain. Vegetation types other than meadows found along the Humboldt include bulrush, cattails, willows, and wildrye (FWS, 1992).

Environmental Impacts

No-Action Alternative. Vegetation is expected to remain relatively unchanged although continuing local development may cause some reduction in selected locations. Vegetation would remain in a significantly degraded state.

Levee, Recreation Trail, and Culvert Alternative. Construction activity to upgrade the south levee would result in the loss of vegetation along the existing levee. However, this vegetation is poor, consisting mostly of intruding upland types, such as annual weeds and greasewood. Quality riparian vegetation within the study reach is minimal. However, loss of existing willows would be a significant adverse impact.

Construction of the drop inlet for culverts could result in the loss of some annual weeds and grasses next to the levee.

Because this vegetation along and adjacent to the south levee is intruding upland species and not riparian, this loss is not considered significant.

Mitigation. Loss of any riparian vegetation, especially willows, would be mitigated through replanting. The Corps would seek the Fish and Wildlife Service's recommendation on mitigation requirements.

Opportunities to restore or enhance riparian vegetation and associated fish and wildlife resources were solicited from the FWS. Although the Corps determined that these opportunities were beyond its authority to implement, the enhancement and restoration measures are contained in the FWS Planning Aid Letter (attachment 2) for future reference.

FISH

Existing Conditions. Historically, the cutthroat trout produced significant numbers in the Humboldt River. However, the trout population decreased significantly after 1900 as water diversions increased and habitat fragmented. By the 1950's, the cutthroat disappeared entirely from the main stem of the Humboldt River.

The State introduced several fish species into the river in the late 1880's, including brown bullhead catfish, Sacramento perch, and carp. In the 1950's rainbow trout, brook trout, largemouth bass, and channel catfish were planted in the Elko vicinity. Plantings in the 1960's also introduced blue gill, white bass, white catfish, and smallmouth bass into the Humboldt River (Nevada DFG, 1974).

A wide variation in flows in the Humboldt River restricts fisheries in the area of Elko. As the riverbed of the Humboldt dries up every year, the fish serve as a food source for predatory birds and mammals. When flows are restored in dried up reaches, fish from upstream and downstream permanent habitats move in to restore fisheries numbers.

Environmental Impacts

No-Action Alternative. Aquatic resources should remain unchanged under this alternative. However, the potential exists for continued degradation of the aquatic ecosystem as riverbanks continue to erode and riparian vegetation is no longer present to provide cover and biofiltration of surface water runoff.

Levee, Recreation Trail, and Culvert Alternative. Raising the south levee could result in impacts to fish in the Humboldt River. Increased sediments and silt from construction operations

could cause short-term impacts to benthic invertebrates from siltation and turbidity. Additional sources of sediments include excavation material storage and staging areas. Another potential impact is spills of petroleum products associated with construction equipment. Diesel fuel, hydraulic fluids, gasoline, and oils that enter the river could cause lethal damage to downstream fisheries and aquatic insect communities.

Construction of the culverts, combined with the levee improvement alternative, would not affect fish resources in the Humboldt River beyond those impacts identified above. Some silt and sediments could pass through the culverts into the river, affecting fish. However, some sediments should settle in the culvert inlet area prior to conveyance through the culverts.

Mitigation. Because the Humboldt River through Elko is often without water during the late summer and early fall, impacts to fisheries could be reduced to less than significant levels if construction is scheduled during that time. Standard construction measures for avoiding or minimizing soil disturbance outside the immediate construction area would be employed. Construction crews would properly use and store petroleum products used during construction to prevent spillage into the river system.

WILDLIFE

Existing Conditions. The study area supports a myriad of wildlife species. Mule deer are the dominant big game species, although numbers are unavailable. Upland mammals in the area include Belding ground squirrel, black-tailed jackrabbit, coyote, and porcupine. Other upland species such as sage grouse, Hungarian partridge, and ring-necked pheasants inhabit the Elko vicinity.

Furbearers such as otters, beaver, muskrats, and mink exist in moderate to high concentrations in the reach of the Humboldt River through Elko.

Approximately 60 species of nongame mammals inhabit lands adjacent to the Humboldt River. These species include the water shrew, raccoon, coyote, red fox, bobcat, ground squirrels, porcupine, and rabbits.

Waterfowl use the Humboldt River and tributaries, but population counts for the Elko area are not available. Ducks and Canadian geese have been noted in the Elko vicinity, as well as green-wing, blue-wing, and cinnamon teal; pintail; gadwall; and goldeneye. A large summer egret rookery nearby supports black-crowned night herons as well as cattle and snowy egrets.

Important nongame bird species found near Elko include willets, sandhill cranes, great blue heron, spotted sandpiper, and the golden eagle. Migratory species in the study area include the rough-legged hawk, American kestrel, common snipe; and rough-winged swallow. Songbirds include the yellow warbler and song sparrow.

Amphibians and reptiles living in the vicinity include the Western toad, bullfrog, sagebrush lizard, wandering garter snake, and Great Basin rattlesnake (Nevada DFG, 1974; FWS, 1992).

Environmental Impacts

No-Action Alternative. Under this alterative, use of the levee by wildlife would remain minimal. Under current conditions, the levee provides no significant habitat or food sources.

Levee, Recreation Trail, and Culvert Alternative. Wildlife would not be significantly affected by this alternative because they do not currently make significant use the levee for habitat or food.

Mitigation. Impacts to wildlife are directly related to the loss of habitat resulting from the project. Affected habitats would be mitigated for with the assumption that wildlife would return to the revegetated areas. The Corps would consult with the FWS for its recommendations prior to the development of a mitigation plan.

In its May 1992 Planning Aid Letter, the FWS examined several enhancement opportunities within the study area, including planting riparian vegetation, planting native vegetation to increase biodiversity, increasing wetlands characteristics upstream of the 12th Street bridge, and placing brush and snags for small mammal cover.

CULTURAL RESOURCES

Cultural resources or historic properties include buildings, structures, objects, sites, districts, and archeological resources associated with historic or prehistoric human activity that are listed in or eligible for listing in the National Register of Historic Places. Such properties may be significant for their historic, architectural, scientific, or other cultural values and may be of national, State, or local significance.

Several laws and regulations require Federal agencies to consider cultural resources during project planning and implementation. Principal among these is the National Historic Preservation act of 1966, as amended (Public Law 95-515). In

particular, the Section 106 review process of this act and implementing regulations (36 CFR 800) guide how a Federal agency should carry out this law.

The cultural resources overview prepared for this environmental evaluation begins the Section 106 process for the proposed undertaking by providing a preliminary review of background information about known and potential historic properties in the area. In accordance with 36 CFR 800.4 (1) (i-iii), the Corps will review existing information on historic properties potentially affected by the undertaking, request the view of the State Historic Preservation Officer (SHPO), and seek information from other parties likely to have knowledge or concerns with historic properties in the area.

Existing Conditions

Archeological Background. Before recent Federally-funded construction projects in the Elko area, archeologists knew little of prehistoric culture in the Elko vicinity except for Steward's 1938 ethnographic study and a few archeological surveys in 1931 and 1968. Archeologists have generally summarized the prehistory of the Elko area from archeological evidence gathered throughout the Great Basin. The prehistory can be broken out into four developmental stages: Pre-Archaic (older than 6,000 B.C.), Early Archaic (5,000-2,000 B.C.), Middle Archaic (2,000 B.C.- 500 A.D.) and Late Archaic (500 A.D. - contact).

Prior to the 1970's, archeological studies tended to be site-specific. A more regional approach to archeological studies began to form in the 1980's. These recent surveys have greatly increased the knowledge regarding the Native American life patterns in and around Elko (Jensen, 1978, Elston, 1986)

Historical Background. The Humboldt River served as a critical landmark for fur trappers and overland settlers who passed through the area on their way to Oregon and California.

In 1868, the Central Pacific Railroad established a station at Elko and laid out a townsite. When the Nevada State Legislature created Elko County in 1869, it named Elko as the county seat (Angel, 1881).

Mining, cattle, and sheep industries kept Elko prosperous until the late 19th century when a drop in silver prices and competitive rail lines led to Elko's decline. Several revivals in mining and a steady ranching economy have kept Elko in existence, unlike many other boom towns (BLM, 1981).

Ethnographic Background. Inhabitants of the Great Basin spoke languages belonging to the Uto-Aztecan family. Native American groups in the study area comprised the Central Numic-

Shoshone linguistic branch, commonly called the Western Shoshone. The Western Shoshone are classic examples of Great Basin hunters and gatherers.

Western Shoshone occupied the upper Humboldt River Valley. The group that lived near the Elko area was known as the Tsokwi yuyukki (BLM, 1981; Thomas, Pendleton, and Cappannari, 1986).

National Register of Historic Places. Two historic cultural resources are listed on the National Register of Historic Places for Elko County. Both are within the city limits of Elko but will not be affected by the project. Seven archeological sites are eligible for listing on the National Register. All seven are outside the study area (National Park Service, 1992).

Methodology. The Corps contacted the Nevada State Museum to perform a records search of the study area. Their records indicated that eight previous archeological surveys have been conducted in the vicinity of the project alternatives. The records search revealed 12 recorded cultural resource sites and 7 isolate sites in the study area. Of these, 10 were prehistoric and 2 were historic sites. Of the 7 isolate sites, four were historic with the remaining three prehistoric. All sites are located within 1 mile of the potential flood control features.

Environmental Impacts.

No-Action Alternative. Impacts to certain cultural resources may occur. Vandalism, agricultural activities, development, and natural causes all potentially impact cultural resources.

Levee, Recreation Trail, and Culvert Alternative. Archeologists for the Elko Railroad Relocation Project surveyed the area involved in this alternative for cultural resources between 1974 and 1980. They found no sites along the current levee alignment. The area considered for the depression basin is within the boundaries of the Elko Railroad Relocation Project cultural resources survey that found no sites. The Nevada SHPO was consulted on whether an additional survey would be required for this alternative. The SHPO determined that no resurvey was needed. The Levee, Recreation Trail, and Culvert Alternative would have no effect on cultural resources.

Mitigation. Because the Levee, Recreation Trail, and Culvert Alternative would have no effect on cultural resources, no mitigation is required. However, if cultural resources are accidently discovered during construction, work in the immediate area should stop until a Corps archeologist can evaluate the situation. Regulation 36 CFR 800.11 provides for any cultural

resource found under such circumstances to be considered under the Section 106 review process.

PALEONTOLOGICAL RESOURCES.

Paleontology is the study of fossils and the fossil record. Fossils are the remains of ancient plant and animal life and are generally found in sedimentary rocks. Fossils also can be found in igneous and metamorphic rocks when lava flows or other geologic occurrences form molds around the organism. Recording and interpretation of paleontological remains help scientists characterize past environments, changes in the earth's climate and surface, and the evolution of biological species.

Existing Conditions. Geologic formations within the study area, along with their sensitivity for containing fossils, are outlined in Table 1. The majority of the formations have some potential for containing fossils. However, this potential generally is low.

Consulting paleontologist Dr. James Firby conducted a literature search of the study area for paleontological resources. The study area has the potential for containing paleontological resources. Dr. Firby's search revealed one paleontological locality within the study area and one locality just outside the study area. The literature search discovered no sensitive or critical sites (attachment 4).

Table 1. Geologic Formations and Fossil Sensitivity in Study Area.

Formation	Sensitivity
Quaternary Alluvium	Low
Older Alluvium	Low
Miocene Tuff, Tuffaceous Sandstone, Conglomerate, Limestone, Interbedded Vitric Tuff including Humboldt Formation	Low
Phenoandestic Flows, Phenolatitic Flows, Pyroclastic Rocks	None
Tuffaceous and Clastic Sedimentary Rocks	Low to Moderate
Welded Tuff, Tuffaceous Sediments, Vitric Ash (Air Fall Tuff)	Low
Lacustrine and Fluviatile Sedimentary Rocks (Elko Formation)	Moderate
Conglomerate	Low
Diamond Peak Formation	Low

Environmental Impacts.

Impacts to paleontological resources include physical destruction due to construction activities, displacement from the stratigraphic context, vandalism, and unauthorized collecting.

No-Action Alternative. Paleontological resources can be affected by continuing local development. Some vandalism and collecting currently occurs.

Levee, Recreation Trail, and Culvert Alternative. Construction impacts to paleontological resources are often difficult to avoid because precise locations often cannot be determined before heavy equipment disturbs them. While the activity of levee raising would not likely affect paleontological resources, borrow material procurement for the levee raising could.

The activities connected with the construction of the culverts could potentially affect formations capable of containing fossils. Potential impacts at that location include destruction, disturbance, submersion, and erosion.

Mitigation. Potential mitigation measures include occasional monitoring of construction sites for fossils, avoidance of potentially fossiliferous sediments for borrow sites, and collection and recordation of fossils uncovered during construction.

Findings

An environmental assessment (EA) would be required to address impacts to environmental resources at the feasibility stage of planning. This EA would concentrate on significant and project-related resource issues within the study area. Scoping coordination with resource agencies, organizations and the public will be accomplished.

Additional Studies Needed

Fish and Wildlife Studies. The Fish and Wildlife Service did not identify any further fish and wildlife studies required during feasibility. It is FWS's opinion that a Habitat Evaluation Procedure would not be required to determine mitigation requirements. A Coordination Act Report will be requested of the FWS, in accordance with the Fish and Wildlife Coordination Act.

A biological assessment would be made of any listed rare, threatened, or endangered species affected by the project. A biological opinion will be requested from the FWS in compliance with Section 7 of the Endangered Species Act.

Water quality and Section 404 (b) (1) studies would be conducted during feasibility. The Corps would coordinate with Federal, State and local water quality control agencies regarding these studies. A 404 (r) exemption will be sought as part of the Congressional authorization of a project.

Should a cost-sharing sponsor be identified, studies of fish and wildlife restoration/enhancement would be conducted.

Cultural Resources Studies. To comply with the Section 106 review process, 36 CFR 800, ER-1105-2-100, and other Federal laws or regulations, the Corps must make a reasonable and good faith effort to identify historic properties that may be affected by its undertaking and gather sufficient information to evaluate the eligibility of these properties for the National Register of Historic Places. Should the project proceed to the feasibility phase of planning, then additional field, scientific, and/or archival studies would be completed. Any sites within the area of potential project effect must be evaluated against criteria established for listing on the National Register of Historic Places. Based on this finding, concurrence of eligibility and a determination of effect will be made in consultation with the SHPO. Evaluation of sites for the National Register of Historic Places and assessment of effects would occur in conjunction with preparation of an environmental impact statement during the feasibility phase.

Recreation Studies. Should the project proceed to feasibility, the Corps would conduct a recreation use and demand study to define additional recreation facilities. Additionally, a cost-sharing sponsor would need to be identified.

List of Preparers and Reviewers

Name Discipline/ Expertise	Experience	Role in Preparation
Jerry Fuentes Social Scientist/ Historian	2 yrs environmental planning studies, Corps	Report Preparation
Fred Kindel Wildlife Biologist/ Environmental Planner	27 yrs environmental planning studies; Corps; 8 yrs State and private wildlife mgt.	Review and editing
Sannie Osborn Archeologist/ Environmental Planner	10 yrs cultural res mgt Corps; 6 yrs museum curator	Report review
Lee Laurence Public Affairs Specialist Writer/Editor	5 yrs public involvement Corps; 1 yr Army Aud Agency; 9 yrs Bureau of Reclamation; 10 yrs Geological Survey	Report review, editing
Dorothy Cornell Technical Publications Writer-Editor	15 yrs planning studies Corps	Report review, editing

References

Angel, Myron
1881 History of Nevada. Thompson and West Publishers, Oakland. Reprinted by Howell-North, Berkeley, 1958.

Bradley, Pete
1992a Personal communication. Nevada Department of Wildlife, Elko.

1992b Wildlife and Wildlife Habitats Associated With the Humboldt River and its Major Tributaries - Humboldt River, City of Elko. Report prepared for the Nevada Department of Wildlife.

Bureau of Land Management
1981 Prehistory, Ethnohistory, and History of Eastern Nevada: A Cultural Resources Summary of the Elko and Ely Districts. Nevada State Office, Reno.

Chilton Engineering
1975 Elko, Nevada, Railroad Relocation Demonstration Project.

City of Elko
1987 Master Plan Update and Infrastructure Plans for the City of Elko, Nevada. Report on file at the office of Elko City Clerk.

Coats, R. R.
1987 Geology of Elko County, Nevada. Nevada Bureau of Mines and Geology Bulletin 101, University of Nevada, Reno.

Elko Chamber of Commerce
1991 City of Elko profile fact sheet. Elko Chamber of Commerce, Elko.

Elston, Robert G.
1986 Prehistory of the Western Area. IN d'Azevedo, Warren, ed., Handbook of North American Indians, Vol. 11- Great Basin. Smithsonian Institution, Washington.

Firby, James
1992 Paleontological Resource Evaluation of Part of the Washoe Valley Area, Elko County, Nevada. Report on file, Sacramento District, Corps of Engineers.

Freeman, Dan
1991 Report on Elko Air Quality 1990. Desert Research Institute, Energy and Environmental Center, University of Nevada. Report prepared for State of Nevada

Environmental Protection, Air Quality Section, Carson City, Nevada.

Hoelscher, Steve
1992 Personal communication. State of Nevada, Division of Environmental Protection, Air Quality Section, Carson City, Nevada.

Jensen, Andrew
1978 Elko 12th Street Borrow Pits. Report on file at the Nevada State Museum, Carson City.

Klein, Michael
1992 Letter to Bob Hahne, project manager, U.S. Army Corps of Engineers.

National Park Service
1992 Index of National Register Listed Properties, Index of Determined Eligible Properties. Computer printouts, on file at U. S. Corps of Engineers, Sacramento District.

National Weather Service
1990 Climatological Summary. Mean for the Period 1941-1900. Report on file at U.S. Corps of Engineers, Sacramento District, Utah Area Office, Bountiful.

Nevada Department of Fish and Game
1974 Inventory and Evaluation of Impacts on Fish and Wildlife for the Humboldt River Upstream Storage Project and the Rock Creek Dam Project. Volume 2, Wildlife Investigation, Nevada Department of Fish and Game, Reno.

Nevada State Demographer's Office
1992 Nevada Population Estimates and Forcasts. Worksheet on file, U.S. Corps of Engineers, Sacramento District, Utah Area Office, Bountiful.

Rawlings, Marcus S. and Larry A. Neel
1989 Wildlife and Wildlife Habitats Associated with the Humboldt River and its Major Tributaries. Biological Bulletin No. 10, Nevada Department of Wildlife, Reno.

Soil Conservation Service
1985 Classification and Correlation of the Soils of the Elko County Central Part. Draft Manuscript. U. S. Department of Agriculture.

State of Nevada
1992 Non-designated Water Quality Management Plan (208) for Nevada. Draft report on file at Nevada Environmental Protection, Water Quality Section, Carson City, Nevada.

Stewart, John H.
1980 Geology of Nevada: A Discussion to Accompany the Geologic Map of Nevada. Nevada Bureau of Mines and Geology. Special Publication No. 4.

Thomas, David Hurst, Lorann S.A. Pendleton and Stephen C. Cappannari
1986 Western Shoshone. IN d'Azevedo, Warren, ed., Handbook of North American Indians, Vol. 11- Great Basin. Smithsonian Institution, Washington.

U. S. Fish and Wildlife Service
1991 Endangered Species Letter. Reno Field Station.

ATTACHMENT 1

FISH AND WILDLIFE SERVICE ENDANGERED SPECIES LETTER

United States Department of the Interior

FISH AND WILDLIFE SERVICE

FISH AND WILDLIFE ENHANCEMENT
RENO FIELD STATION
4600 Kietzke Lane, Building C-125
Reno, Nevada 89502-5093

November 5, 1991
File No.: 1-5-92-SP-14

Mr. Walter Yep
Chief, Planning Division
U.S. Army Corps of Engineers
1325 J Street
Sacramento, California 95814

Dear Mr. Yep:

Subject: Species List for Proposed Elko Flood Control Project

Your letter of October 18, 1991, requested a list of threatened and endangered species that may occur in the Elko reach of the Humboldt river. According to our records, no listed, proposed, or candidate species are found near the project area.

This response fulfills our requirement to provide a list of species under section 7(c) of the Endangered Species Act of 1973, as amended. We appreciate your consideration and look forward to continued cooperation.

If you have any questions, please contact Betsy Whitehill at FTS 470-5227. Thank you for your interest.

Sincerely,

David L. Harlow

David L. Harlow
Field Supervisor

ATTACHMENT 2

FISH AND WILDLIFE SERVICE PLANNING AID LETTER

United States Department of the Interior

FISH AND WILDLIFE SERVICE
FISH AND WILDLIFE ENHANCEMENT
RENO FIELD STATION
4600 Kietzke Lane, Building C-125
Reno, Nevada 89502-5093

May 11, 1992
File No. COE 3-6

Laurence R. Sadoff, Colonel
Sacramento District
Army Corps of Engineers
1325 J Street
Sacramento, California 95814-2922

Dear Colonel Sadoff:

Attached is the final Planning Aid Report (PAR) provided by the Fish and Wildlife Service for the U.S. Army Corps of Engineers, Sacramento District, for the Washoe Valley at Elko, Nevada, Flood Control Reconnaissance Study. It has been prepared under the authority of, and in accordance with the provisions of, the Fish and Wildlife Coordination Act (48 Stat. 401, as amended; 16 U.S.C. § 661, et. seq.). It is not intended to fulfill section 2(b) of the Fish and Wildlife Coordination Act.

Comments from your staff have been addressed in the final PAR, and alternatives have been revised to reflect current project proposals as of April 28, 1992. We look forward to working with you and your staff should this study continue into feasibility-level investigations.

If you have questions or wish to consult with us about this PAR, please contact Betsy Whitehill of my staff at 702-784-5227.

Sincerely,

Randy M. McHatt

David L. Harlow
Field Supervisor

Attachment

Flood Control Reconnaissance Study for the Washoe Valley at Elko, Nevada

Planning Aid Report

Prepared for the

Sacramento District
U.S. Army Corps of Engineers

by

U.S. Fish and Wildlife Service
Fish and Wildlife Enhancement
Reno, Nevada

Betsy Whitehill , Fish and Wildlife Biologist, Author
David L. Harlow, Field Supervisor

May 1992

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

INTRODUCTION

This is a planning aid report (PAR) of the U.S. Fish and Wildlife Service (Service) as requested in the Army Corps of Engineers (Corps) January 7, 1992, Scope of Work for the Washoe Valley at Elko, Nevada, Flood Control Project. As a reconnaissance level field investigation, the purpose of this PAR is to provide information to the Sacramento District of the Corps on important fish and wildlife resources within the project area located along the Humboldt River through Elko and several washes on the southern side of the city. It identifies fish and wildlife issues and concerns which may arise in the planning process for implementing levee modifications and designing a flood detention basin. As specified in the Preliminary Alternatives and Scope of Work documents, an environmental alternative is included. Flood storage restoration capability within the gravel pits and floodplain area upstream of the 12th Street Bridge will be discussed concurrently with the previously stated flood control measures. Because of the preliminary stage of project development, the Corps should be aware that our concerns may change as further project details are developed and become available.

Findings in this PAR are based on various reports, documents, and published and unpublished information, as well as maps, photos, and project descriptions provided by the Corps. Nomenclature and taxonomic order of birds in Appendix A follows the American Ornithologists' Union Check-List of North American Birds (AOU, 1983); that of mammals as found in Revised Checklist of North American Mammals North of Mexico, 1986 (Jones et. al., 1986); and reptiles and amphibians according to the Checklist of Vertebrates of the United States, the U.S. Territories, and Canada (Fish and Wildlife Service, 1987). Appendix B, a listing of plant species recommended for revegetation purposes, follows Munz's A California Flora and Supplement (1974). Project information provided by the Corps is currently broad in scope; therefore, our comments are generally nonspecific. Additional information was obtained from consultation with individuals familiar with the project area.

PROJECT AREA INFORMATION AND LOCATION

The project area is located in Elko, a northeastern Nevada community of about 16,000 residents, that is situated along the Humboldt River. For purposes of this study, the project area encompasses the gravel pits and river channel to the utility corridor upstream of the 12th Street Bridge on the east, downstream to the Bullion Bridge on the west, and three tributaries on the south side of the river (Figure 1).

The Humboldt River Basin is the largest watershed in Nevada (Nevada Department of Wildlife, 1989). The valley floor and its floodplains for the Humboldt River were an important route for portions of the California Emigrant Trail and the first transcontinental railway built in 1869. Development of towns, agricultural fields and pasture along the river during the past century have altered the physical and biological character of the system and the wildlife habitats associated with its floodplains.

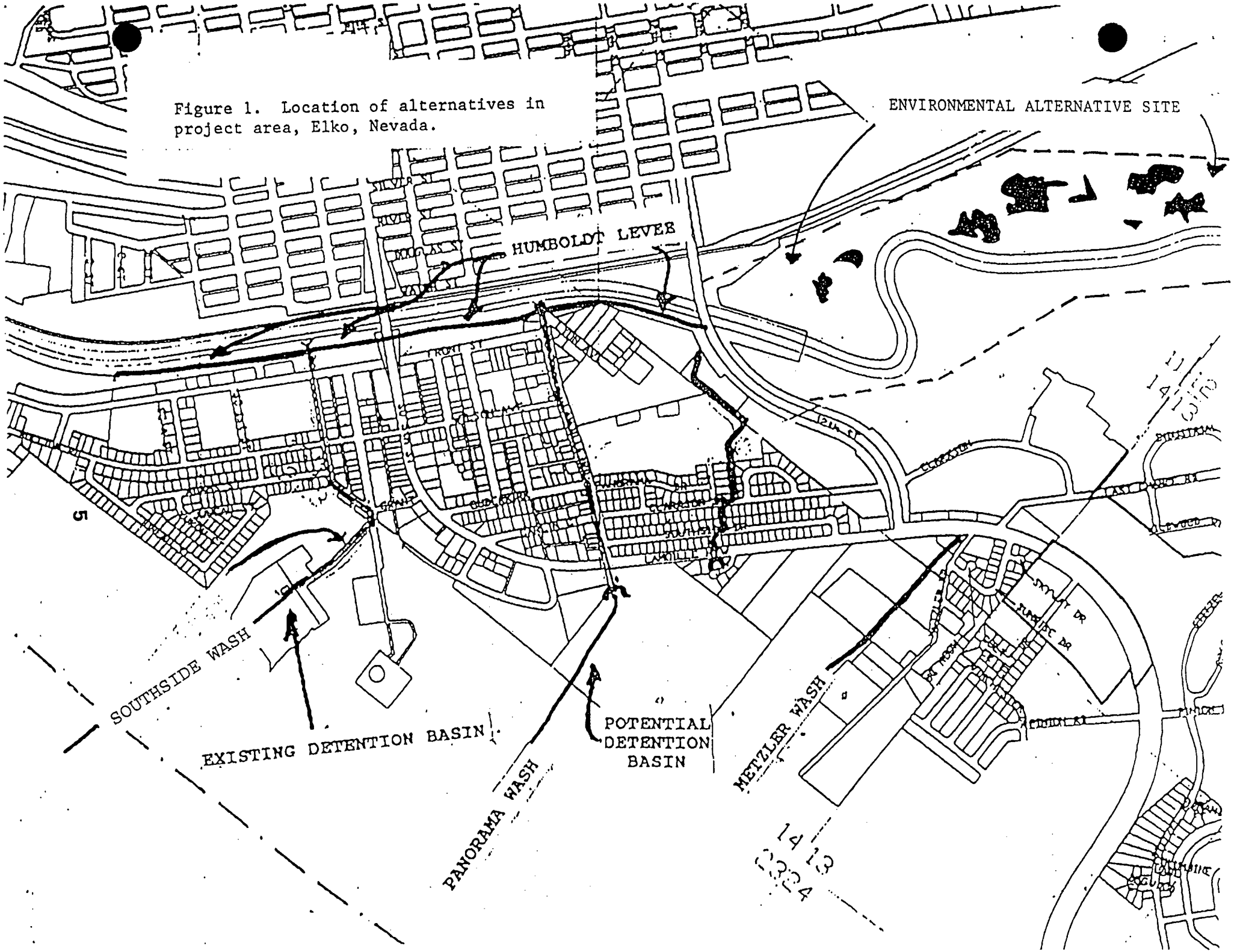


Figure 1. Location of alternatives in project area, Elko, Nevada.

Mountain ranges surrounding the Elko area rise to elevations of 11,387 feet. Flooding from spring runoff of the snowmelt (wet mantle) and intense rainstorm events at other times of the year (dry mantle) have caused property damage as the river flowed through the city. Twelve wet mantle floods and five dry mantle floods have occurred between 1870 and 1962 (U.S. Fish and Wildlife Service, 1964). See Figure 2.

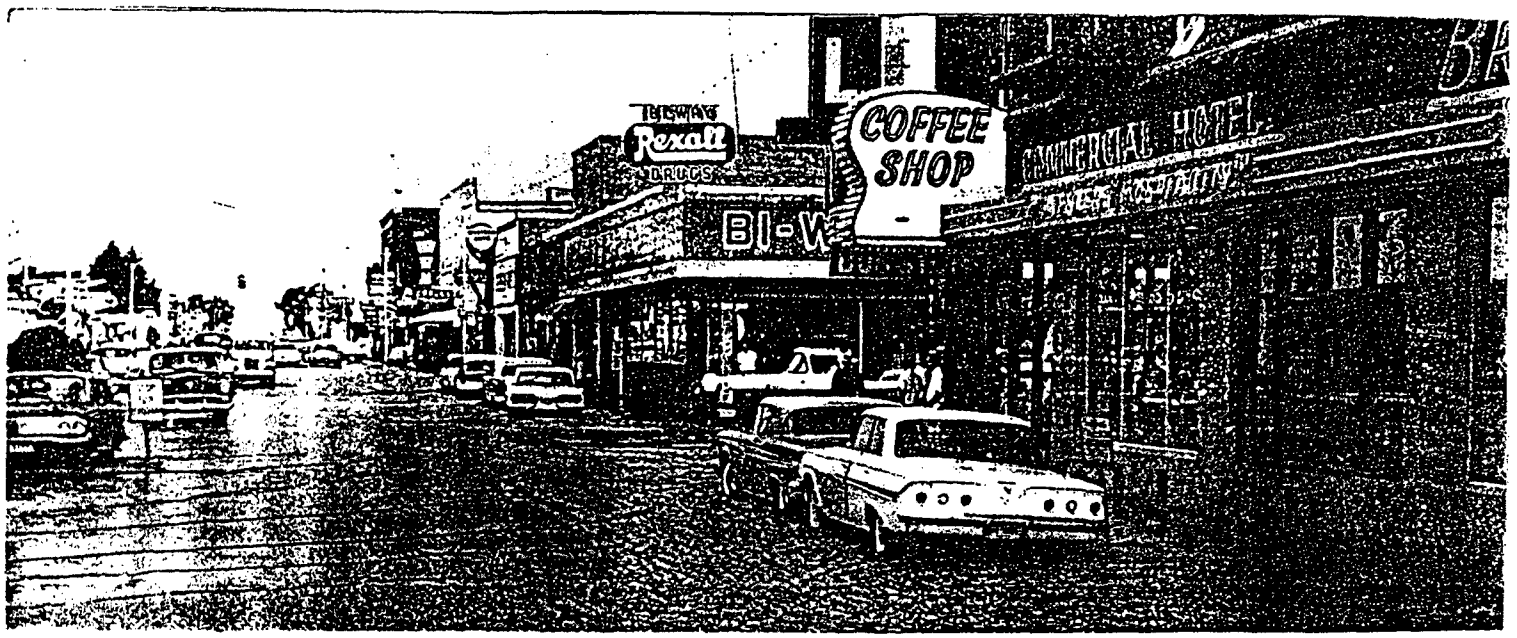


Figure 2. Dry-mantle floodwaters in downtown Elko, August 6, 1961 (U.S. Fish and Wildlife Service, 1964).

The Humboldt River through Elko has been channelized to reduce the threat of flood damage to the downtown area. As a result, there is minimal bankside vegetation along most of this reach. Railroad tracks run parallel to the river along its north side, and a set-back levee is located on the south side, separating the river channel from a residential neighborhood, apartment complex, and elementary school. Upstream from the 12th Street Bridge, a private parcel of land containing numerous abandoned gravel pits lies adjacent to the river. Again, disturbance from previous surface mining activities and bank scouring during high flow events have left the river banks in a degraded condition. Along the southern edge of Elko, residential property damage has resulted from the effects of runoff after severe storm events moving down from several natural tributary drainages which historically flowed into the Humboldt. The Elko wastewater treatment facility, located approximately one-half mile downstream of the Bullion Bridge, is at risk of potential encroachment from a secondary river channel that threatens the dikes surrounding the emergency water storage ponds (Figure 3). Serious damages could result in high flow events (Ferron Konakis, City of Elko, pers. comm.). Private property owners have lost valuable agricultural lands through bank erosion and silt deposition during flood events since the city reach has been channelized (Bruce Williams, Young Ranch, pers. comm.).

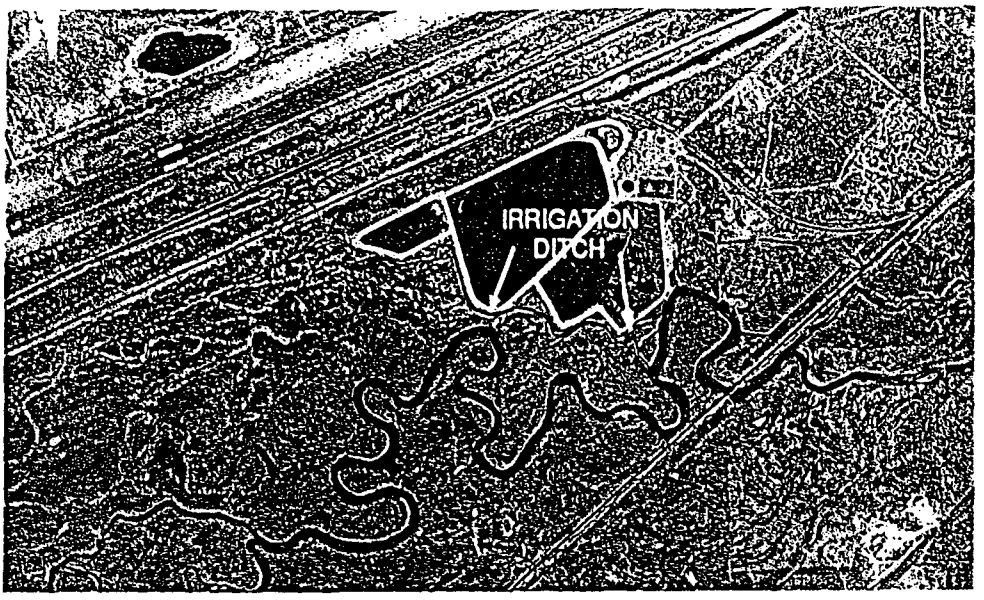


Figure 3. The Humboldt River channel near the Elko wastewater treatment facility in 1979 before the channelization of the upstream city reach (Nevada Department of Wildlife, 1989).

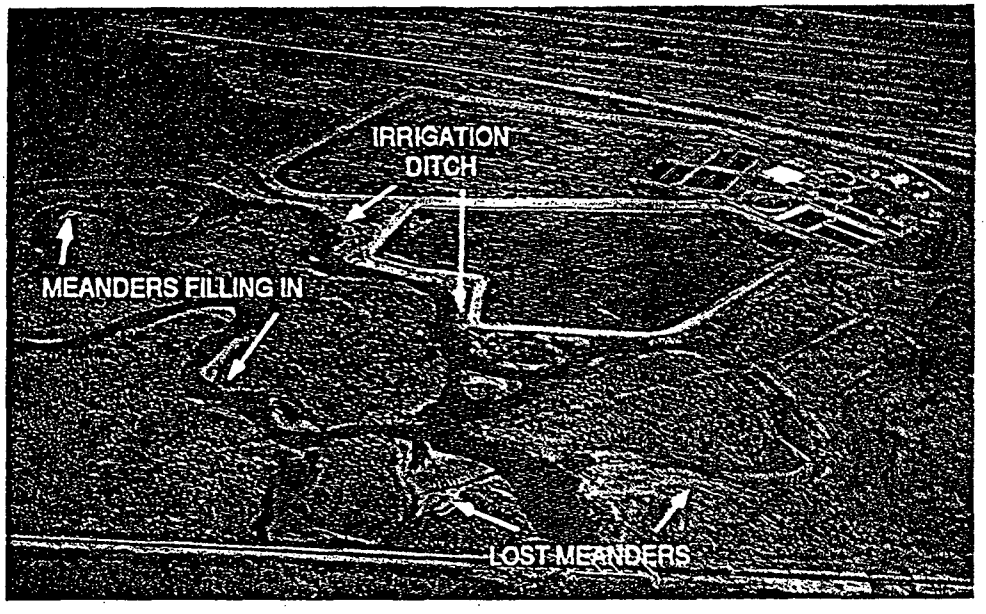


Figure 4. Enlargement of the irrigation ditch into a secondary channel adjacent to the emergency water storage ponds. Photo taken in 1987 (Nevada Department of Wildlife, 1989).

PROJECT DESCRIPTION

Local interests have requested that the Corps evaluate the current flood threat based upon control measures already in place, and develop further measures that might better protect the community during heavy spring runoff and localized storm events. Preliminary measures provided to the Service for fish and wildlife resource impact assessment are as follows:

1. Refurbish the entire length of the south levee along the Humboldt River downstream of the 12th Street Bridge.

2. Construct a detention basin on Panorama Wash. Two sizes are being considered, with the larger designed to contain 100 year flows. The river outlet would be comprised of piping or an open channel.

3. Construct a small depression basin on a presently vacant site immediately downstream of the 12th Street Bridge on the south side of the levee . Three pipes with flap gates would be installed at the outlet of the basin through the levee to facilitate transport of flows into the river channel

4. Construct a detention basin on Metzler Wash. Alternatives for outlets to the river are the same as above.

5. Develop an environmental enhancement/restoration alternative in coordination with the Service.

Additionally, the Corps is investigating a modified riverside use plan encompassing a "greenbelt" theme between the river channel and levee. This may include limited recreational facilities such as bike paths, picnic tables, and natural areas.

Upon subsequent review and analysis by the Corps, three preliminary measures have been retained as alternatives: #1, #2, and #3. Alternative #1, the levee refurbishment alternative, has been expanded to include raising the levee. Alternative #2, the Panorama Wash detention basin, will remain an alternative, but the Metzler Wash detention basin has been dropped from further consideration. Alternative #3, pipes with flap gates, is a different method than a detention basin but would acheive the same flood control objective. Although no longer an alternative, discussions pertaining to the environmental/enhancement alternative will remain in the document text for informational purposes.

AQUATIC RESOURCES

Historically, Lahontan cutthroat trout (LCT) resided in a large portion of the Humboldt River system. As water diversions increased and habitat became fragmented, LCT decreased in number and range and presently occupy only 12 percent of their former geographical area within the Humboldt Basin. There are no LCT in the mainstem of the Humboldt River at this time.

Introduced warm water species, including blue-gill, catfish, bullhead, and small-mouth bass, are found in the river and gravel pits. When the pits and riverbed through Elko dry up during late summer months, the fish serve as a food source for predatory birds and mammals or swim up or downstream to find suitable habitat (Pat Coffin, U. S. Fish and Wildlife Service, pers. comm.).

The tributaries flowing from Panorama and Metzler Washes are ephemeral in nature, so aquatic resources are not a factor. Water routes from the detention basins to the river most likely would not contain water other than at high runoff conditions.

WILDLIFE RESOURCES

Wildlife surveys along the Humboldt River were conducted by the Nevada Department of Wildlife (NDOW) during the summer of 1986. Species/habitat relationships were observed and recorded for both birds and mammals, and previously collected data were used to identify reptiles and amphibians present or known to occur in the system (Nevada Deapartment of Wildlife, 1989).

Natural drainage areas on the southern edge of Elko provide upland habitat for raptors, songbirds, small mammals, and reptiles (Pete Bradley, NDOW, pers. comm.). Vegetative make-up consists primarily of a big sagebrush-rabbitbrush (Artemisia tridentata - Chrysothamnus) type community, although historically it may have had a significant percentage of Great Basin wild rye (Elymus cinereus).

The riparian plant community has functioned as an important wildlife habitat system throughout the Humboldt River Valley and the Great Basin. Birds use willow thickets for nesting, foraging, and cover. Mammals utilize the natural corridor for traveling and cover as well. Stream shading by overhanging vegetation maintains suitable temperatures for fish and other aquatic resources, and the root masses within the riparian zone help stabilize banks, retain and slowly disperse flood flows, and filter out non-point source pollutants.

Within the project vicinity, wildlife habitat ranges from poor to moderate. Downstream of the Bullion Bridge, percolation ponds connected with the Elko wastewater treatment plant have provided winter resting sites for waterfowl (Lois Port, Northeastern Nevada Naturalists, pers. comm.). Species observed on the ponds include green-winged, blue-winged, and cinnamon teal, pintail, gadwall, lesser scaup, and goldeneye. A large summer egret rookery nearby supports black-crowned night herons as well as cattle and snowy egrets (Ryser, 1985).

Quality riparian habitat along the study reach from the 12th Street Bridge to the Bullion Bridge is minimal. Willow stands occur in one or two locations, but most of the vegetation found in this stretch is composed of annual weeds and volunteer shrubs. Because of flows evident above and below the disturbed area, it appears that the river flows at a sub-surface level during the late summer and early fall months. Upstream of the 12th Street Bridge, however, wildlife habitat includes both riverine and wetland ecosytems as well as upland plant communities. Again, the functions and values to wildlife fluctuate with the water level in the river channel. Sandbar willow stands are sporadic through this reach and quickly interface with big sagebrush-rabbitbrush vegetation in the destabilized bank areas and upland floodplain. Mammals observed along the river such as mink, otter, muskrat, and beaver, are representative of this type of system. Upland mammals include mule deer, black-tailed jackrabbit, Belding ground squirrel, coyote, and porcupine. Shorebirds observed in the summer and fall include great blue heron, avocet, spotted sandpiper, and black-necked stilt (Lois Port, Northeast Nevada Naturalists, pers. comm.). Several of the abandoned gravel pits support cattail and other emergent plant species which provide nesting cover and food

sources. During "normal" water years, the pits hold water through most months (Leonard Hoskins, retired NDOW, pers. comm.). Songbirds and raptors, including a bald eagle, have been listed during various bird counts, surveys, and casual observations. For a more complete species list of wildlife that may be found along the river in the project vicinity, including reptiles and amphibians, see Appendix A.

THREATENED AND ENDANGERED SPECIES

Table 1 lists sensitive species that may be present in the project area. Several candidate and one listed species have been known to occur in the project vicinity. Category 2 candidate status includes taxa for which information now in the possession of the Service indicates that proposing to list them as endangered or threatened species is possibly appropriate, but for which substantial data on biological vulnerability and threat(s) are currently not known or on file to support the immediate preparation of rules.

Table 1. Sensitive animal species that are found or that could be present in the project area.

Common Name[1]	Scientific Name[1]	Federal Status[2]	State Status[2]	Blue List[3]
Birds				
Great blue heron	Ardea herodias			X
Black-crowned night heron	Nycticorax			X
White-faced ibis	Plegadis chihi	C2	S	
Bald eagle	Haliaeetus leucocephalus	E		
Northern harrier	Circus cyaneus			X
Short-eared owl	Asio flammeus			X
Loggerhead shrike	Lanius ludovicianus	C2		
Yellow warbler	Dendroicia petechia			X
Amphibian				
Spotted frog	Rana pretosa	C2		

[1] Scientific nomenclature and common names follow: Banks, et.al.(1987); AOU (1983); Jones, et. al. (1986).

[2] Status

Federal: E = endangered; T = threatened; C2 = category 2 candidate for listing (taxa for which FWS lacks sufficient data on vulnerablity and threats)

State: E = State list of endangered species; S = sensitive

[3] National Audubon Society Blue List, an early warning system for bird species whose numbers are in decline (Tate, 1986).

A bald eagle was observed in January 1992 at the geothermal springs downstream of the Bullion Bridge (Lois Port, Northeastern Nevada Naturalists, pers. comm.). This federally listed endangered species often follows waterfowl

along their winter migration routes and can be found around bodies of water throughout Nevada during this time of the year.
White-faced ibis breed primarily in the Great Basin states. During the nesting season, the birds historically foraged in backwater sloughs and flooded wet meadows along the Humboldt and other river systems in the region (Pete Bradley, NDOW, pers. comm.). This Category 2 candidate bird species was once common in great numbers in the marshes of the Ruby Lakes National Wildlife Refuge, located approximately 30 miles from Elko across the Ruby Mountain Range. NDOW reported no colonies on or near the city floodplain, but ibis still frequent flood-irrigated agricultural lands adjacent to the Humboldt River east of Elko (Dan Pennington, U.S. Fish and Wildlife Service, pers. comm.).

The loggerhead shrike, also a category 2 candidate species, inhabits valleys and foothills of the Great Basin, often around the outskirts of ranches and towns (Ryser, 1985). The birds may be present in the summer among desert shrubs, pinyon-juniper woodlands, and mountain mahogany stands. Habitat loss is the major threat to this species.

Limited information is available concerning the spotted frog in Nevada. It is known to occur in the Humboldt River drainage, and several sightings have been recorded on tributaries north of Elko, (U.S. Fish and Wildlife Service files). This species was included in the 1991 Federal Register Animal Notice of Review under category 2 status.

FUTURE WITHOUT THE PROJECT

Detention Basin: If no detention basin is developed on Panorama Wash, there would be no decrease of property damage risk in the adjacent residential areas resulting from severe rainstorm events. Residential development within this drainage is a distinct possibility in the future (Michael Klein, City of Elko, pers. comm.). Without the project, wildlife use throughout the southern flank of drainages would remain at its present level or decrease. Housing development may have an adverse effect on habitat loss and fragmentation and may further aggravate the storm runoff problem that already exists. Sealing off natural soil absorption and drainage functions of this draw by the construction of driveways, houses, and roads, could potentially increase sheet runoff during storm events.

Levee System: Should the levee system remain unchanged from its present state, flood control protection would remain at its current level, waterfront improvements may not be implemented, and wildlife values for the reach would remain low. Significant changes to existing wildlife resources within the project area are not expected. Wildlife habitat will remain largely unsuitable along the levee and minimal in the cobble bench between the river channel and levee system. Aquatic resources would remain unchanged.

Gravel Pits/Floodplain Site: This approximately 300-acre site is presently under private ownership and is zoned industrial (Michael Klein, City of Elko, pers. comm.). The owner recently was considering surface mining the uplands for gravel and is interested in working with the city to protect the existing

wetlands and river channel on the property, possibly through a land exchange (Mary Jo Elpers, U.S. Fish and Wildlife Service, pers. comm.). If this option is not adopted, bank destabilization will progress, and the abandoned pits and floodplain will continue to function in their present capacity. Most significantly, damage will continue to occur on public and private lands downstream of Elko as a result of high flows being flushed through town in the channelized section of the river.

Fish and wildlife resources would likely remain unchanged or worsen with no project development. Degradation to aquatic ecosystems may occur from increased siltation as riverbanks continue to erode and riparian vegetation is no longer present to provide cover and biofiltration of surface water runoff. Riverine wildlife habitat quality would maintain its current low to moderate state.

FUTURE WITH THE PROJECT

Predictions of potential fish and wildlife impacts, both positive and negative, are general in nature. As the study progresses and construction and engineering become more detailed, the accuracy of the impact assessment can be further refined. The Corps should be aware that our analysis is preliminary, and additional impacts may be identified at a later time that could influence project development.

Aquatic Resources

Due to a lack of water in the river channel through the project reach during several months of the year, aquatic populations may not be directly affected by the project, as presently proposed, depending upon when work takes place. Construction activities that occur during months when water is present could release large amounts of sediments and silts into the aquatic environment, causing short-term impacts to benthic invertebrates from siltation and turbidity. Riverbed or riverside work associated with the connecting channels or piping from Panorama Wash and other tributaries, improperly stored excavation materials, construction staging areas, and other related construction activities may also be sources of siltation and turbidity. This situation could be minimized with the use of silt fencing and removal of accumulated soil at the end of the construction phase.

Installing pipes through the levee to direct storm flow runoff from the tributaries into the river channel is appropriate. In general, sediment accompanying such flows is a natural function of the system and should not have significant adverse impacts to the channel. However, the Corps should evaluate the extent to which erosion from man-caused activities is occurring compared to natural sediment movement into the channel. No fishery exists in this reach. Flushing flows from the Humboldt would dissipate deposits made from tributary sources by carrying the sediment load downstream or depositing it throughout the channel bottom. Pipes should be installed at a height to prevent excess sediment from entering at the basin inlet. Flap gates on the outlet end of the pipes would prevent most river water from entering into the drains but may also be a point of debris collection on the inside. Debris

screens are recommended at the upstream end of the pipes. These safety features would preclude wildlife as well as small children from entering the culverts.

Spills of petroleum products associated with construction works could severely harm local and downstream fish habitat. Diesel fuel, hydraulic fluids, gasoline, and oils or oil-based chemicals that enter the interior drainage system or river may cause extensive lethal damage to downstream fish and aquatic insect communities.

Wildlife Resources

From the fish and wildlife resource perspective, development of the project presents several potential benefits. If the associated riverside park development and upstream habitat enhancement opportunities are taken into consideration, benefits could be even more significant. These benefits are explained in more detail under the Fish and Wildlife Opportunities section of this report.

Detention Basin: Construction of a small flood control detention basin for temporary storage of floodwaters in the tributary drainage may have a long-term benefit for wildlife in that the upland habitat utilized would remain relatively undisturbed. Displacement of resident wildlife or wildlife using this area transitionally is likely to be localized to the area of construction activity and to the time period of construction. The actual effects to birds, mammals, and other wildlife would be indeterminate at this time, but would be expected to be temporary because the degree and duration of disturbance at any one location should be small. However, it is possible that slow moving and burrowing animals could be killed during heavy equipment operations. Most of the project area is located close to human activity and development where significant adverse impacts to wildlife resources would not be expected.

Levee System: The current levee provides little if any wildlife value. An earthen and gravel embankment vegetated by annual weeds, it provides no significant habitat or food source for animals. Refurbishing the levee and flood plain could provide benefits to wildlife if the reach were vegetated with native herbaceous and shrub plantings. The set-back feature of the system can accommodate growth of riparian and wildlife plants incorporated into a natural or park-style setting, as suggested by the Humboldt Area River Project (HARP). Levee improvements could benefit wildlife if done properly. If levee and floodplain refurbishment includes providing vegetation for wildlife enhancement, then increased levels of waterfowl, songbirds, raptors, and other species can be expected. Native trees, shrubs, and other vegetation can provide nesting, cover, and food sources for birds, small mammals, and other wildlife. Low herbaceous vegetation may provide feeding sites for waterfowl, particularly Canada geese. These tangible benefits for wildlife, in turn, may increase the local economy since local businesses would benefit from the people who would be attracted to the area because of the improved quality of the environment. In general, levee and flood plain enhancement proposals incorporating landscape features for wildlife resources presently have support from State and Federal resource agencies as well as the Northeast Nevada Naturalists.

Gravel Pits/Floodplain Site: Utilizing this site as a self-functioning natural flood storage area would provide tangible benefits to property owners downstream of the city because high flows would dissipate and lose much of their destructive force. Collectively, these artificial wetlands absorb and hold spring snowmelt runoff and discharge it more slowly back into the system. A study by Owaga and Male (1983) summarized the usefulness of wetlands in reducing downstream flooding increases. The usefulness of the wetland varies with: (a) The size of the wetland area; (b) the seriousness of the flooding downstream of the wetland; (c) the size of the flood; (d) the proximity to the upstream wetland; and (e) the lack of other storage areas such as reservoirs. It may be possible to enhance or enlarge the present wetland system to accommodate up to 100-year flood levels.

PRELIMINARY RECOMMENDATIONS

The following recommendations are based on current project information furnished by the Corps. These measures are to assist the Corps study planning process in order to ensure that adverse impacts to existing fish and wildlife resources are avoided or minimized. Specific mitigation measures for anticipated or unavoidable losses and adverse impacts to fish and wildlife resources will need to be developed once project designs and details become available.

Mitigation should be implemented by the Corps for natural resource losses resulting from project-related activities associated with the retention basins. Mitigation can involve a series of actions as defined by the National Environmental Policy Act, as amended, 42 U.S.C. § 4321, et. seq. These include the following: (1) Avoiding the impact altogether; (2) minimizing the impact; (3) rectifying the impact; (4) reducing or eliminating the impact over time; and (5) compensating for the impact over time. Service mitigation goals range from no loss of in-kind habitat values to minimal loss of habitat values (U.S. Fish and Wildlife Service Mitigation Policy, 1981). If uplands are impacted, the Service may recommend ways to minimize or rectify losses through habitat value improvements. Compensation may be recommended depending on the significance of the potential loss. The Service's Region 1, which includes Nevada, maintains a policy of no net loss of wetland acreage or values. This policy also supports the President's no net loss of wetlands goal.

Habitat values in the project area range from moderate to low for fish and wildlife. Based on existing information, the project is not expected to result in significant changes that would have an adverse impact on existing habitat values. Further, if levee and flood plain revegetation proposals are part of the project, and wildlife enhancement measures are included, significant benefits to fish and wildlife resources are anticipated.

The Service recommends the following mitigation/enhancement measures. These measures would prevent losses and mitigate, enhance, and/or compensate fish and wildlife resources affected by the project. In the event of significant changes or further major developments in project designs, our recommendations will be subject to re-evaluation. In addition, if future studies identify additional impacts, our recommendations would likely be modified.

In order to provide protection from floodplain habitat losses, as has been experienced within the project area in the past, Executive Order 11988, Floodplain Management, directs all Federal agencies to " . . . avoid to the extent possible, action in the floodplain that encourages, allows, serves, or otherwise facilitates additional development." The Service suggests the Corps levee modifications be designed to comply with the Executive Order to the maximum extent possible.

Construction scheduling should be timed to minimize adverse impacts on fish and wildlife, and instream or riverward work should occur when the river channel is dry. Size of construction sites (e.g., staging areas, access roads) should be kept as small as possible. Revegetation efforts should be timed to reduce erosion potential and maximize success of the plantings. We recommend that only native grasses, shrubs, and trees be used. Appendix B is a list of suggested native plant species for wildlife plantings.

Chemicals, fuels, oils, and other potentially toxic materials should be properly used and stored. Measures should be taken to prevent spilled petroleum products from entering the river system, tributaries, interior drainage system, and riparian zone.

FUTURE STUDIES

At this time, the Service has not identified any fish and wildlife studies that would be required in order to assess impacts. Satisfactory data exist on wildlife resources throughout the project area to determine mitigation requirements without conducting a Habitat Evaluation Procedure (HEP). Should the project proceed to the feasibility phase, a Coordination Act Report would be developed by the Service pursuant to the Fish and Wildlife Coordination Act. The Corps must determine if a listed species may be affected by the action. If a listed species may be affected, the Corps should enter into consultation with the Service, pursuant to section 7 of the Endangered Species Act (Act). A Biological Assessment may be required of the Corps for compliance under the Act.

FLOOD CONTROL AND STORAGE ENHANCEMENT OPPORTUNITIES

Besides the wetland system described earlier in the text, there are several other options that are briefly mentioned below. They are site specific and may be considered separately or as a whole, depending on the degree of benefits desired. All would provide long-term values to fish and wildlife resources.

* Restoring channel sinuosity above the 12th Street Bridge would recreate historical flow-reducing functions of the river system. Re-establishing riparian vegetation along the banks and recontouring the pits adjacent to the river to function as backwater sloughs or seasonal marshes would increase the present storage capability of the existing site features.

* Restoring a slight degree of sinuosity between the study area bridges would again help slow down high velocity flows and give the area a more natural appearance. The most appropriate location for such a contour feature would be between the pedestrian and 5th Street Bridges.

* Restoring the main river channel to its former meander route downstream of the Bullion Bridge would result in similar velocity and flow dissipation effects as stated above. At present, the channel continues its undeviating course with resulting bank-scouring consequences, affecting properties even farther downstream.

FISH AND WILDLIFE ENHANCEMENT OPPORTUNITIES

In addition to enhancing wildlife habitats through levee and floodplain revegetation along the channelized section of the Humboldt, the most significant opportunities and benefits for fish and wildlife resources lie in the site upstream of the 12th Street Bridge. Enhancement opportunities include, but are not limited to, those discussed below.

* Revegetation with riparian plant species along the river shoreline would provide a wildlife corridor for mammals, perching and nesting sites for birds, and a more diverse food source for both. Bank stabilization and ground water storage are additional advantages and historical functions.

* Restore biodiversity to the area by establishing plantings for wildlife that encompass species indigenous to the Humboldt River Valley and northeastern Nevada. As the variety of plants increase, bird and mammal species that use them likely would increase as well. Such plantings would further expand food sources and cover types, and in the case of cottonwoods, provide roosting sites for raptors. Buffaloberry, serviceberry, and Great Basin wild rye are examples of good wildlife plants. For a more complete listing of recommended species, see Appendix B.

* Enhancement measures to increase wetland characteristics in the gravel pits can be very beneficial to fish and wildlife. Regrading existing slopes to develop shallow water habitat for establishment of emergent plants may increase waterfowl and shorebird use and provide cover for warmwater fish species.

* Placement of brush heaps and fallen snags in the uplands around the gravel pits area would provide cover for small mammals.

* Fish habitat could be improved by arranging boulders and other large natural organic debris in the riverbed at optimum locations throughout the floodplain reach.

POTENTIAL DEVELOPMENT BY NON-FEDERAL INTERESTS

The Service believes that, if the HARP is implemented, fish and wildlife resources would benefit along with the community of Elko. Areas that are currently unsuitable for wildlife habitat along the project reach and are planned for "greenbelt" development could be enhanced, with the potential to support wildlife for the benefit of the people. By increasing wildlife habitat values of an area, the quality of the human environment is also enhanced.

In keeping with the greenbelt-riverside park theme, the site above the 12th Street Bridge has been identified as a potential part of the project. The wetland, riverine, and upland ecosytems are a natural outdoor education laboratory. Walking paths, observation platforms, and interpretive kiosks would combine to offer an outstanding learning and recreational environment for local residents and visitors alike. Birdwatching, nature walks, photography opportunities, and habitat enhancement work in the form of putting up nesting boxes and wildlife plantings by local youth, conservation, and civic organizations all increase support for the fish and wildlife resources in the Elko community.

LITERATURE CITED

American Ornithologists' Union (AOU). 1983. Check-list of North American birds. American Ornithologists' Union.

Erwin, K.L. 1990. Wetland evaluation for preservation and creation. In: J. Kusler and M. Kentula (eds.), Wetland creation and restoration. Island Press. pp. 429-449.

Jones, J., D.C. Carter, H.H. Genoways, R.S. Hoffman, D.W. Rice, and C. Jones. 1986. Revised checklist of North American mammals north of Mexico. Occassional Paper No. 107. Museum Texas Tech University.

Munz, P. 1974. A flora of southern California. University of Southern California Press, Berkeley, California.

Nevada Department of Wildlife. 1989. Wildlife and wildlife habitats associated with the Humboldt river and its major tributaries. Biological Bulletin No. 10, Reno, Nevada.

Ogawa, H., and J.W. Male. 1983. The flood mitigation potential of inland wetlands. Water Resources Research Publication No. 138, University of Massachusetts, Amhurst.

Ryser, F.A. 1985. Birds of the Great Basin. University of Nevada Reno Press, Reno, Nevada.

Tate, J., Jr. 1986. The blue list for 1986. American Birds. 40:227-236.

U.S. Fish and Wildlife Service. 1981. Mitigation Policy. Notice of Final Policy. Federal Register. 46:7644-7663.

U.S. Fish and Wildlife Service. 1987. Checklist of Vertebrates of the United States, the U.S. Territories, and Canada. Resource Publication 166, Washington D.C.

U.S. Fish and Wildlife Service. 1991. Endangered and threatened wildlife and plants; Animal candidate review for listing as endangered or threatened species, proposed rule; Notice of review. Federal Register. 56:58804-58836.

U.S. Fish and Wildlife Service. Endangered species office files, ETS-6-7. Spotted frog. Fish and Wildlife Enhancement, Reno, Nevada.

U.S. Forest Service, Soil Conservation Service. 1964. Water and related land resources, Humboldt River Basin, Nevada. Report No. 7, USDA, SCS, Portland, Oregon.

Appendix A

Common Name	Scientific Name

Animal species that are found or that could be present in the project area. List is compiled from a 1986 NDOW survey and bird counts conducted by the Northeast Nevada Naturalists, 1988-1991.

Mammals

Nuttal's cottontail	Sylvilagus nuttallii
Black-tailed jackrabbit	Lepus californicus
Least chipmunk	Tamias minimus
Belding ground squirrel	Spermophilus beldingi
Beaver	Castor canadensis
Muskrat	Ondatra zibethicus
House mouse	Mus musculus
Porcupine	Erethizon dorsatum
Coyote	Canis latrans
Mink	Mustela vison
River otter	Lutra canadensis
Mule deer	Odocoileus hemionus

Birds

Great blue heron	Ardea kherdias
Great egret	Casmerodius albus
Snowy egret	Egretta thula
Cattle egret	Bubulcus ibis
Black-crowned night heron	Nycticorax nycticorax
White-faced ibis	Plegadis chihi
Canada goose	Branta canadensis
Wood duck	Aix sponsa
Green-winged teal	Anas crecca
Mallard	Anas platyrhynchos
Northern pintail	Anas acuta
Blue-winged teal	Anas discors
Cinnamon teal	Anas cyanoptera
Northern shoveler	Anas clypeata
Gadwall	Anas strepera
Lesser scaup	Aythya affinis
Common goldeneye	Bucephala clangula
Bufflehead	Bucephala albeola

Appendix A (cont.)

Common Name	Scientific Name
Bald eagle	Haliaeetus leucocephalus
Northern harrier	Circus cyaneus
Rough-legged hawk	Buteo lagopus
American kestrel	Falco sparverius
Killdeer	Charadrius vociferus
Black-necked stilt	Himantopus mexicanus
American avocet	Recurvirostra americana
Willet	Catoptrophorus semipalmatus
Spotted sandpiper	Actitus macularia
Long-billed dowitcher	Limnodromus scolopaceus
Common snipe	Gallinago gallinago
Wilson's phalarope	Phalaropus tricolor
Rock dove	Columba livia
Short-eared owl	Asio flammeus
Black-chinned hummingbird	Archilochus alexandri
Belted kingfisher	Ceryle alcyon
Downy woodpecker	Picoides pubescens
Northern flicker	Colaptes auratus
Western kingbird	Tyrannus verticalus
N. rough-winged swallow	Stelgidopteryx serripennis
Black-billed magpie	Pica pica
American crow	Corvus brachyrhynchos
Common raven	Corvus corax
American dipper	Cinclus mexicanus
Ruby-crowned kinglet	Regulus calendula
Townsend's solitare	Myadestes townsendi
American robin	Turdis migratorius
Northern mockingbird	Mimus polyglottos
Water pipit	Anthus spinoletta
Loggerhead shrike	Lanius ludovicianus
European starling	Sturnus vulgaris
Yellow warbler	Dendroica petechia
Song sparrow	Melospiza melodia
White-crowned sparrow	Zonotrichia leucophrys
Harris sparrow	Zonotrichia querula
Dark-eyed junco	Junco hyemalis
Red-winged blackbird	Agelaius phoeniceus
Western meadowlark	Sturnella neglecta
Brewer's blackbird	Euphagus cyanocephalus
House finch	Carpodacus mexicanus
House sparrow	Passer domesticus

Appendix A (cont.)

Common Name	Scientific Name
Reptiles*	
Western skink	Eumeces skiltonianus
Western whiptail	Cnemidophorus tigrus
Desert collared lizard	Crotaphytus insularis
Long-nosed leopard lizard	Gambela wislizenii
Desert spiny lizard	Sceloporus magister
Sagebrush lizard	Sceloporus graciousus
Western fence lizard	Sceloporus occidentalis
Side-blotched lizard	Uta stansburiana
Short-horned lizard	Phrynosoma douglassii
Desert-horned lizard	Phrynosoma platyrhinos
Rubber boa	Charina bottae
Common garter snake	Thamnophis sirtalis
Western terrestrial garter snake	Thamnophis elegans
Ringneck snake	Diadophis punctatus
Long-nosed snake	Rhinocheilus lecontei
Ground snake	Sonora semiannulata
Night snake	Hypsiglena torquata
Gopher snake <>	Pituophis melanoleucus
Racer	Coluber constrictor
Striped whipsnake	Masticophis taeniatus
Western rattlesnake	Crotalus viridis
Amphibians*	
Great Basin spadefoot	Scaphiopus intermontanus
Western toad	Bufo boreas
Pacific treefrog	Hyla regilla
Spotted frog	Rana pretiosa
Northern leopard frog	Rana pipiens
Bullfrog	Rana catesbeiana

* Species thought to occur on the Humboldt River system (NDOW, 1989).
<> Species observed in project area

APPENDIX B

Native plants for revegetation of disturbed riparian and wetland systems.

Common Name	Scientific Name
Riparian species	
Golden currant	Ribes aureum
Wild rose	Rosa woodsii
Serviceberry	Amelanchier alnifolia
Fremont cottonwood	Populus fremontii
Sandbar willow	Salix exigua
Silver buffaloberry	Sheperdia argentea
Squaw bush	Rhus trilobata
Great Basin wild rye	Elymus cinereus
Wetland emergent species	
Cattail	Typha spp.
Hardstem bulrush	Scirpus spp.

ATTACHEMENT 3

CULTURAL RESOURCES REPORT

(Report on file at Sacramento District)

ATTACHMENT 4

PALEONTOLOGICAL RESOURCES REPORT

PALEONTOLOGICAL RESOURCE EVALUATION OF PART OF THE WASHOE VALLEY AREA, ELKO COUNTY, NEVADA

Prepared for: DEPARTMENT OF THE ARMY
CORPS OF ENGINEERS, SACRAMENTO
PURCH. ORDER NO. DACW05-92-P-0772

Prepared by: JAMES R. FIRBY
CONSULTING PALEONTOLOGIST

SUBMITTED BY: James R. Firby
James R. Firby

February 12, 1992

PALEONTOLOGICAL RESOURCE EVALUATION OF PART OF THE WASHOE VALLEY AREA, ELKO COUNTY, NEVADA

INTRODUCTION

A literature search for paleontological and related geological references was conducted for a section of Washoe Valley, Elko County, Nevada. The study area lies within portions of sections 11, 12, 13, 14, 15, 22, and 23, T. 34 N., R. 55 E., as shown on the U. S. G. S. Elko East and Elko West 7 1/2 minute quadrangles, 1962 photo-revised 1975 editions. One locality which is known to have produced paleontological resources lies within and one locality lies outside but adjacent to the study area, and are noted on figur 1. Other areas with a potential for paleontological resources were examined, but no fossils were noted. The single locality within the area is recorded to have produced both vertebrate (mammal) and plant fossils, which reside in the collections of the University of California Museum of Paleontology. Other lithologies deemed to have a potential for paleontological resources were examined during field confirmation of Feb. 7, but no further fossils were discovered. The original site of the Miocene locality is now in the center of a recently erected mobile home park, and no longer available for examination. Floral and faunal lists from some nearby sites are reported below, under the appropriate formation and age of units which are known to occur within the study area. No sensitive and critical sites were discovered within the study area. Pertinent literature is cited,

with annotation, at the end of this report.

EVALUATION OF FORMATIONS WITHIN STUDY AREA

Most of the designations used herein follow Coats (1987) usage, and sensitivity ratings follow the general usage for both paleontology and archaeology as used by the Bureau of Land Management. Map designations, as used by Coats (ibid), are given in parentheses.

QUATERNARY ALLUVIUM (Qa) and OLDER ALLUVIUM (Qta)

Alluvium and terrace deposits of the Humboldt river within the area were cursorily examined for paleontological resources with negative results. While it is possible that some vertebrate (mammal) fossils may be discovered in the older (Qta) sediments, none have been reported. This is the age of sediments most apt to be disturbed during any work adjacent or within about a quarter mile south of the Humboldt River; as is usually the case with this type of unit, any fossil material would most likely be discovered during excavation for construction.

Sensitivity of both units is considered low (S-3 or less).

MIOCENE TUFF, TUFFACEOUS SANDSTONE, CONGLOMERATE, LIMESTONE, AND INTERBEDDED VITRIC TUFF; INCLUDES THE HUMBOLDT FORMATION (Ts3).

This heterogenous lithology contains the best potential for vertebrate (mammal) fossils within the area. The sedimentary units, in particular the sandstone lithosome, have a higher potential than the air fall tuff. Fossil mammals have been recorded from the Humboldt Formation at many different sites, and

any outcrop of the Humboldt must be considered to have paleontological potential. An outcrop of the Humboldt Formation occurs in the center of section 22, and is covered by a mobile home park. Mammals recorded from this locality include the horse Merychippus species, and an antilocaprid Merycodus species. Fossil flora, with numerous taxa, are known from this locality and housed at U. C. Berkeley and other institutions. The preservation of fossil material is uniformly poor, which is probably fortunate considering the now total inaccessibility of this site. The locality is noted in the Paleontological Inventory of the Elko Bureau of Land Management District (Firby and Schorn, 1983) as P-5 and V-5, on the overlay of the 1:100,000 Elko surface management map. This locality was noted as being in the top part of an abandoned mine shaft, long since collapsed, and further in-filled prior to construction in the area; no surface exposure of the Humboldt is visible at the coordinates, only an overlying tuff unit. The age of the flora and fauna is Miocene; the sensitivity must be rated as low (S-3) in view of the covering of the site by construction of the mobile home park.

Another outcrop of the Humboldt occurs just north of the study area, and is not known to be fossiliferous.

PHENOANDESITIC AND PHENOLATITIC FLOWS AND PYROCLASTIC ROCKS (Ta2).

Volcanic phenocrystalline rocks of ?Early Miocene age, not known to contain any fossils. There is no paleontological potential in these rocks.

TUFFACEOUS AND CLASTIC SEDIMENTARY ROCKS (Ts2).

Small area less than one mile south of the northeastern part of study area (in the NW 1/4 of section 24) is a tuffaceous sandstone referable to this lithology. This area was examined as part of the field work of February 8, and no fossils were noted. Similar age sediments elsewhere have been noted to contain Arikareean age mammalian fossils.

Sensitivity of this lithology should be considered low to moderate (S-2 to S-3), however the attitude (strike and dip) of the strata exposed at this outcrop appear to preclude occurrence within the study area.

WELDED TUFF, TUFFACEOUS SEDIMENTS, AND VITRIC ASH (AIR-FALL TUFF) (Tw).

This sequence includes the Indian Well Formation, which has potential for paleontological resources. The only occurrence within the study area is a small outcrop in a road cut near State Highway 46, and appears to be mostly vitric ash tuff, with no fossil content.

LACUSTRINE AND FLUVIATILE SEDIMENTARY ROCKS (Ts1).

Within the Elko area this unit is the Elko Formation, of Eocene age, and known to produce fossil flora and occasional mammalian fossils. One locality just south of the study area, in the SW 1/4 of section 23, T. 23 N., R. 55 E., is known to have produced a fossil leaf flora, first reported by Lesquereux (1883). Attitude of the strata trend into the area of concern, but no significant localities were noted. This locality is called "South Elko" in the records of the University of California Museum of

Paleontology, and is assigned the locality number P-3949 by that institution. Floral elements include Metasequoia (the "dawn redwood"), Ulnus, Acer (2 species), and the Oregon grape Mahonia. Fossils from this locality are not well preserved. Locality lies within patented land, according to the BLM land use map. Sensitivity is moderate, S-2.

CONGLOMERATE (Tc).

Eocene chert and quartzite well rounded clasts typify this unit, which lies locally in conformity with the overlying Elko Formation. Elsewhere, this unit includes the Meadow Fork Formation, but it is not clear if the limited outcrops of this lithosome in the study area are referable to that formation. Matrix is generally cemented by silica, and occasionally tuffaceous; usually stained by iron oxides. No fossils are recorded from this unit within the study area. Sensitivity is low, S-3.

DIAMOND PEAK FORMATION (PMdp).

Restricted outcrop of this Late Paleozoic unit occurs the southern and eastern boundaries of the study area. Marine invertebrate fossils are known to occur within the unit, but are not considered to be a significant resource. The closest outcrop of PMdp to the area seems to have no fossil content. Significance and sensitivity of this unit is low, S-3 or less.

ANNOTATED BIBLIOGRAPHY

AXELROD, D. I. 1966. The Eocene Copper Basin flora of

northeastern Nevada. University of California Publications in Geological Sciences, v. 59, p. 1-125.

Notes: Although dealing with the flora of the Dead Horse Tuff, in the Bull Run Mountains, many taxa are common with that from the Elko Formation, at least at a generic level.

CLINE, R. B. 1967. Fusulinid paleontology and paleoecology of eastern Nevada. M. S. thesis, University of Nevada, Reno.

Notes: Discussion of biostratigraphic foraminiferal correlations of Late Paleozoic fossiliferous strata within several areas, including the Elko area. Pertinent to the Pennsylvanian and Late Mississippian Diamond Peak Formation (PMdp), above.

COATS, R. R. 1987. Geology of Elko County, Nevada. Nevada Bureau of Mines and Geology Bulletin 101, University of Nevada, Reno; 112 p. and geologic map.

Notes: Prepared in cooperation with the United States Geological Survey, this is a key reference for geologic and stratigraphy within and adjacent to the study area; it is also a prime reference source for geology and paleontology.

DICKINSON, K. A. AND F. M. SWAIN 1967. Late Cenozoic freshwater Ostracoda and Cladocera from northwestern Nevada. Journal of Paleontology, v. 41, no. 2, p. 335-350.

Notes: Fossil Ostracoda and Cladocera occúr within the lacustrine facies of the Humboldt Formation (Ts3, above).

DOTT, R. H. Jr. 1955. Pennsylvanian stratigraphy of Elko and northern Diamond ranges, northeastern Nevada. American Association of Petroleum Geologists Bulletin, v. 39, p. 2211-

2305.

Notes: A useful source of ancillary references, and for paleontology and stratigraphy of the Diamond Peak Formation, which occurs within the study area.

FIRBY, J. R. 1990. The Miocene James Creek local fauna, Humboldt Formation, Eureka County, Nevada. in Elston, R. G. and E. E. Budy, editors, The Archaeology of James Creek Shelter, Appendix C, University of Utah Anthropological Papers, no. 115, p. 289-294.

Notes: Although geographically removed from the study area, it deals with the mammalian fauna and age of the Humboldt Formation. The occurrence of Merychippus is recorded from the same formation in Elko and the James Creek areas, and they appear to be the same species. The observations on the age and current concepts on the restrictions of the Humboldt Formation apply to both areas.

FIRBY, J. R. AND H. E. SCHORN 1983. Paleontological inventory of the Elko Bureau of Land Management District, v. II, BLM contract number YA 553-CT1-108. p. 1-640.

Notes: Comprehensive bibliography through 1982, containing 238 references to Elko County paleontology and over 400 site locations of fossil vertebrate, invertebrate, and paleobotanical resources, with their individual evaluations.

HEDLUND, R. W. 1965. Sigmopollis hispidus genus et species novum, from Miocene sediments, Elko County, Nevada. Pollen et spores, v. 7, no. 1, p. 89-92.

Notes: Identification of fossil pollen from the Humboldt

Formation.

JAEGER, K. B. 1987. Structural geology and stratigraphy of the Elko Hills, Elko County, Nevada. M. S. thesis, University of Wyoming. (no pagination available in present copy)

Notes: Applicable to stratigraphy of all units in T. 34 N., R. 55 E.

MACDONALD, J. R. 1949. A new Clarendonian fauna from northeastern Nevada. University of California Publications Bulletin, Department of Geological Sciences, v. 28, p. 173-194.

Notes: Mammalian fauna of Miocene age from the Humboldt Formation from localities in Elko County and Eureka County.

---------- 1966. The Barstovian Camp Creek fauna from Elko County, Nevada. Los Angeles County Museum Natural History Quarterly, v. 4, no. 3, p. 18-22.

Notes: Mammalian fauna from lower part of Humboldt (unrestricted) and correlative units. The Barstovian is Middle Miocene, and older than the overlying Clarendonian strata more typical of the Humboldt Formation. Given the sequence within the study area, it is quite possible that at least part of what has been mapped as Ts3 by Coats (1987) is assignable to this age. This paper describes the fauna and related faunas within Elko County.

REGNIER, J. . 1960. Cenozoic geology of the vicinity of Carlin, Nevada. Geological Society of America Bulletin, v. 71, p. 1189-1210.

Notes: Redefinition and restriction of the Humboldt Formation in

the sense of Sharp (1939).

SHARP, R. P. 1939. The Miocene Humboldt Formation in northeastern Nevada. Journal of Geology, v. 67, p. 133-160.

Notes: Original definition of the Humboldt Formation, later re-defined by Smith and Ketner (1975) and Regnier (1960). The present usage and constraints on the extent of the Humboldt is summarized by Firby (1990), and basically follows the usage of Smith and Ketner (ibid).

SMITH, J. F. Jr. AND K. B. KETNER 1975. Geology of the Carlin - Pinon Range area, Nevada. United States Geological Survey Professional paper 867-A.

Notes: This is the principle work which re-defines the extent and usage of the Humboldt Formation, and it is in the sense of this paper that the Humboldt is regarded in most literature.

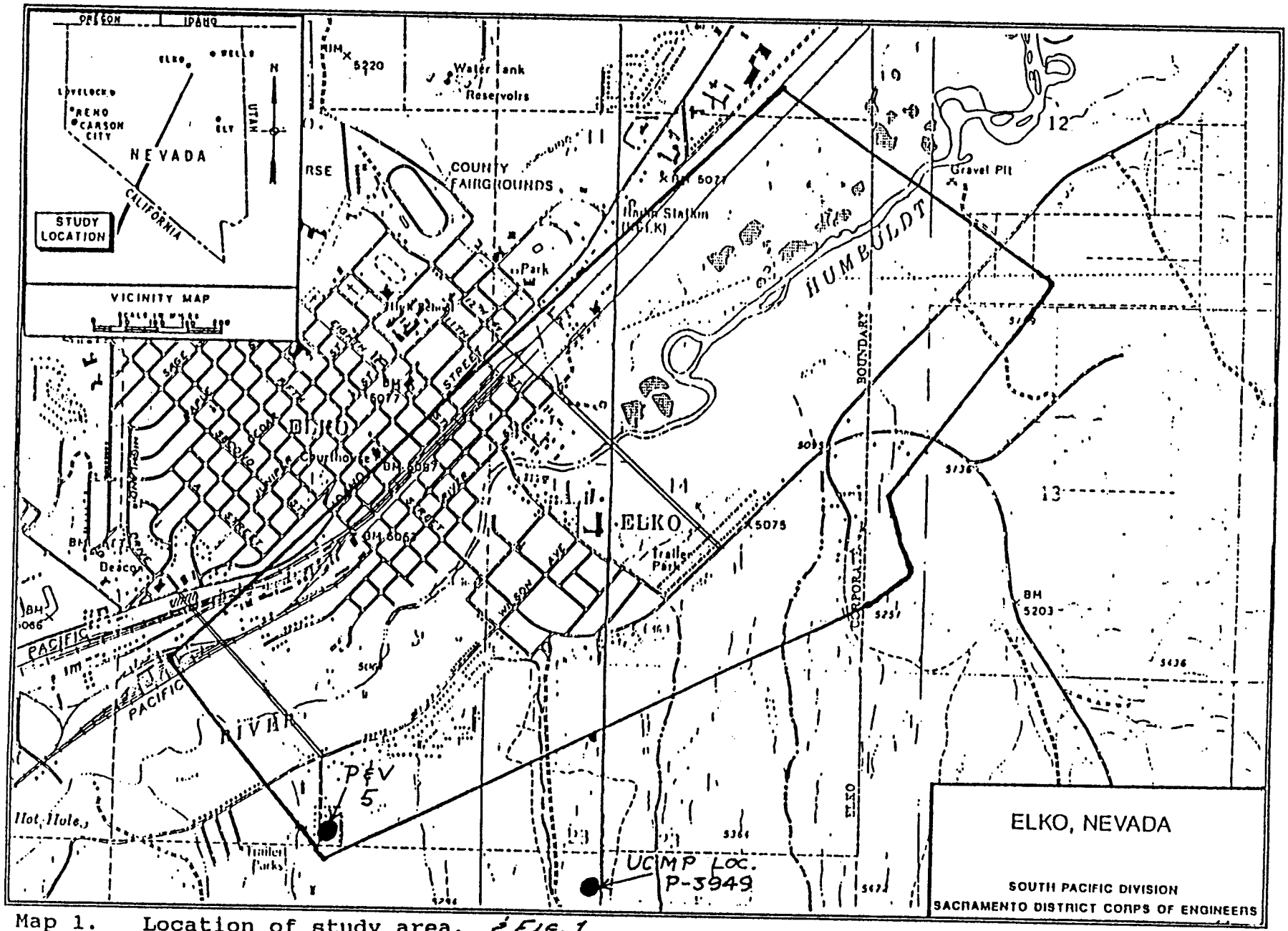
STEWART, J. A. AND J. E. CARLSON 1978. Geologic map of Nevada. United States Geological Survey, in cooperation with the Nevada Bureau of Mines and Geology, 1:500,000 scale.

Notes: This map is considered authoritative on most units of all ages in Nevada. The map of Coats (1987) shows more detail for Elko County, but follows the usages and terminology of this map.

WINGATE, F. H. 1983. Palynology and age of the Elko Formation (Eocene) near Elko, Nevada. Palynology, v. 7, p. 93-132.

Notes: The Elko Formation can be confused with the Humboldt and other Tertiary units if only the lithology is considered; thus any added paleontological data that serves to set it apart is

important. Several pollen taxa noted and discussed.



Map 1. Location of study area. ¢ FIG. 1

Reconnaissance Report
Washoe Valley at Elko, Nevada

ATTACHMENTS

A Economic Analysis

B Feasibility Cost-Sharing Agreement

C Initial Project Management Plan

D Office Report, Basis of Design and Cost Estimates, September 1992

E Pertinent Correspondence

ATTACHMENT A

ECONOMIC ANALYSIS

ECONOMIC ANALYSIS

ELKO PROJECT
ELKO RECONNAISSANCE STUDY
HUMBOLDT RIVER
(NORTH, SOUTH, AND TRIBUTARIES)

US Army Corps Of Engineers
Sacramento District
Economics Branch
October 1992

ECONOMIC ANALYSIS
ELKO RECONNAISSANCE STUDY
HUMBOLDT RIVER (NORTH, SOUTH, AND TRIBUTARIES)

TABLE OF CONTENTS

LIST OF TABLES

ECONOMIC ANALYSIS
ELKO RECONNAISSANCE STUDY
HUMBOLDT RIVER (NORTH, SOUTH, AND TRIBUTARIES)

I. INTRODUCTION

The purpose of this report is to present the economic analysis used to measure the beneficial contributions of a flood damage reduction project for the Humboldt River South, without-project damages for the Humboldt River (North) and its three Tributaries in southern Elko, Nevada. The Humboldt River South project under consideration is a levee with a 100-year level of protection; no project has been formulated as of this date for either the Humboldt River (North) or the three Tributaries. All economic benefits have been developed in accordance with ER 1105-2-100. This report presents a description of the methodology used to develop damages and benefit-cost ratios. Benefits and costs are expressed as average annual values at a Federal discount rate of 8.5 percent and a project life of 50 years. The project base year is 1998, and all benefits, costs, and damages are expressed in October 1992 price levels.

As mentioned earlier, Project Lifesaver reduced the potential for flooding, but there is still a chance that extensive flood damages will occur. There have been past floods at Elko; however, there is no documentation of the damages on the north or south overbank of the Humboldt River or from the tributary streams.

II. FLOOD PLAIN INVENTORY

a) Area

The flooding from the Humboldt River (North and South) occurs from snowmelt and general rain events, while the Tributary flooding is strictly from cloudburst events. These events would happen at different times of the year and are separated for an incremental economic analysis. Since a project for the Humboldt River North and Tributaries was initially deemed infeasible, only without-project damages were computed.

b) Inventory

The field inventory was carried out by economists from the Army Corps of Engineers and was inventoried through site visits. Structures in the flood plain are categorized as follows: Residential, Multi-Residential, Mobile Home, Commercial, Public, and Sheds. Foundation heights of the structures were determined structure-by-structure during an onsite visit. The Tributaries flood plain has 694 existing structures in the 500-year, 290 structures in the

100-year, and 174 structures in the 50-year. The Humboldt River North flood plain has 245 structures in the 500-year and 223 structures in the 166-year. The Humboldt River South flood plain has 577 structures in the 500-year, 389 structures in the 100-year, and 269 structures in the 33-year. Tables 1A and 1B show the number of structures by land use.

c) Value of Damageable Property

The value of structures was determined by site visits and discussions with local real estate professionals, as well as the use of the Marshall and Swifts Valuation Service real estate handbook to verify that structures were valued at replacement costs minus depreciation.

For residential, multi-residential, and mobile home structures, content values are 50 percent of structure value. For commercial and public structures, the value of content percentages was based on information in the Lake Pontchartrain Study prepared by the Lower Mississippi Valley Division in 1980. Based upon past District studies, these content percentages are considered to be appropriate for this study area due to similar construction or building types.

Total depreciated replacement value of all flood plain structures and contents for the Tributaries are $28.6 million in the 500-year, $11.7 million in the 100-year, and $7.5 million in the 50-year flood plains. The Humboldt River North depreciated replacement values are $18.8 million in the 500-year and $16 million in the 166-year flood plains, while depreciated replacement values for Humboldt River South are $18.6 million in the 500-year, $12.5 million in the 100-year, and $9.9 million in the 33-year flood plains. Structure and content values by land use for specific flood events are shown on Tables 1A and 1B.

d) Future Growth & Development

Since most of the flood plain area is developed and there are no plans of new development in the vacant areas, no future growth was assumed for the flood plain.

III. FLOOD DAMAGE EVALUATION

Based on data presented in the preceding paragraphs, flood damages were computed by determining relationships between damageable property values and depths, flows, and frequencies of flooding. The following will discuss these relationships at greater length.

TABLE 1A

TOTAL NUMBER OF EXISTING STRUCTURES
HUMBOLDT RIVER (NORTH, SOUTH, AND TRIBUTARIES)

Humboldt River South Bank	33-year	100-year	500-year
Single-Family Residential	101	107	120
Multi-Family Residential [1]	2	2	2
Mobile Homes	113	223	380
Commercial	7	9	10
Public	3	3	3
Sheds	43	45	62
Total	269	389	577
Humboldt River North Bank	**166-year**	**500-year**	
Single-Family Residential	88	102	
Multi-Family Residential [1]	2	3	
Mobile Homes	91	91	
Commercial	31	38	
Public	0	0	
Sheds	11	11	
Total	223	245	
Southside Tributaries	**50-year**	**100-year**	**500-year**
Single-Family Residential	41	84	148
Multi-Family Residential [1]	2	4	6
Mobile Homes	114	165	429
Commercial	1	1	17
Public	3	3	6
Sheds	13	33	88
Total	174	290	694

[1] Assumes 12 units/structure.

TABLE 1B

TOTAL VALUE OF DAMAGEABLE PROPERTY
HUMBOLDT RIVER (NORTH,SOUTH, AND TRIBUTARIES)
($1,000)

Humboldt River South Bank	33-year	100-year	500-year
Single-Family Residential	5,475	6,045	6,390
Multi-Family Residential [1]	270	270	270
Mobile Homes	2,807	4,670	10,227
Commercial	1,275	1,460	1,533
Public	0	0	0
Sheds	95	99	147
Total	9,922	12,544	18,567
Humboldt River North Bank	**166-year**	**500-year**	
Single-Family Residential	4,020	4,695	
Multi-Family Residential [1]	135	225	
Mobile Homes	2,355	2,355	
Commercial	9,408	11,520	
Public	0	0	
Sheds	44	44	
Total	15,962	18,839	
Southside Tributaries	**50-year**	**100-year**	**500-year**
Single-Family Residential	2,295	4,530	7,925
Multi-Family Residential [1]	1,200	1,935	2,670
Mobile Homes	3,654	4,928	12,164
Commercial	85	85	3,288
Public	195	195	2,365
Sheds	29	73	198
Total	7,458	11,746	28,610

[1] Assumes 12 units/structure.

a) Types of Damages

The principal types of flood damages considered in this analysis are those physical damages and costs that are caused by inundation. Physical losses include all structures and contents in the six land use categories shown earlier as Residential, Multi-Residential, Mobile Home, Commercial, Public, and Sheds. The content damages include furnishings, equipment and fixtures, raw materials, goods in production, and finished goods. Other physical losses include damages to lot improvements and damages to roads.

Although there are agricultural lands within the total basin and much of the economy for the Humboldt River is related to agriculture, no agricultural lands are within the flood plains analyzed in this study. Therefore, crop damages were not evaluated.

Damage/Benefit Categories

1) Residential, Multi-Residential, Mobile Home, and Shed losses include content, structure, and yard area damage.

2) Commercial losses include structure and content, raw materials, inventory, fixture, and equipment.

3) Public losses include structure and content, as well as damages to churches and schools.

4) Road damages include replacement and cleanup costs of damages to all roads and parking lots created by flood inundation.

5) Auto damages include losses to structure and content at various depths.

6) Emergency costs include costs for flood fighting; disaster relief; and extra police, fire, and military units. Intangible damages such as loss of life and impaired health and living conditions cannot be evaluated in monetary terms and hence are not included in this analysis.

b) Depth-Damage Relationships

Based on the data presented in preceding paragraphs, flood damages were estimated by determining relationships between damageable property values and the anticipated depths of flooding. Depths of flooding range from sheetflow to 3.5 feet in the Tributaries flood plain, sheetflow to 7 feet in the Humboldt River North flood plain, and from sheetflow to 8 feet in the Humboldt River South flood plain.

Depth-damage relationships indicate the percent damages are likely to occur under different depths of flooding. The 1988 Federal Emergency Management Agency depth-damage

relationships were used for residential and public structures. The depth-damage relationships developed by the Tennessee Valley Authority for the Department of Housing and Urban Development in December 1969 were used in estimating damages to commercial and industrial structures. The similarity in types of construction between structures found in Elko and those encountered in previous district studies was the basis for using these depth-damage curves. Verification of these curves has been undertaken in other district studies, and they have been found to be appropriate. A breakdown of depth-damage curves is shown on Table 2. For autos, the depth-damage relationships were derived by the Soil Conservation Service in 1983 for the Lower Silver Creek Watershed project.

IV. AVERAGE ANNUAL DAMAGES

a) Without-Project Conditions

Average annual damages are the expected value of flood damages for a given economic condition and point in time. They are determined by weighing the estimated damages from varying degrees of flooding by their probability of occurrence and may be approximated by measuring the area under the damage-frequency curve using standard mathematical integration procedures. Damages by flood event for structures and contents under existing conditions are shown on Table 3 for the Tributaries, Humboldt River North, and Humboldt River South. The nondamaging frequencies and flows for the three flood plains are a 5-year event and 115 cfs for the Tributaries, a 110-year event and 13,000 cfs for the Humboldt River North, and a 32-year event and 7,100 cfs for the Humboldt River South area.

b) With-Project Conditions

Residual damages are the average annual damages remaining under the "with-project" condition. Under project conditions, the flow-damage relationship is the same, while the frequency-damage relationship changes due to an adjustment in the flow-frequency curve. In other words, damages are the same for both with- and without-project conditions for any given flow in a flooded area. The flow is redefined, however, and becomes a less frequent event under project conditions.

V. BENEFIT EVALUATION (FLOOD CONTROL)

a) Inundation Reduction

Inundation reduction benefits were estimated by evaluating damages for the proposed alternative. The project that was considered for the Humboldt River South economic analysis consisted of a levee with a 100-year level of protection. Only without-project damages were determined through economic analysis for the Tributaries and Humboldt River North. Initial screening indicated that even if all of the without-project damages were captured, neither the

TABLE 2

DEPTH-DAMAGE RELATIONSHIPS

DEPTH OF FLOOD	RES & MULT STR. 1-STORY	RES & MULT CONT. 1-STORY	RES & MULT STR. 2-STORY	RES & MULT CONT. 2-STORY	MOBILE HOMES STR.
-1	0	0	0	0	0
0	7.7%	11.3%	5.0%	7.4%	8.3%
.5	10.6%	17.2%	7.0%	9.0%	26.3%
1.0	13.5%	23.1%	9.0%	10.5%	44.3%
1.5	16.9%	27.5%	11.0%	14.3%	53.8%
2.0	20.4%	31.7%	13.0%	18.0%	63.2%
2.5	23.5%	33.2%	15.5%	20.3%	68.3%
3.0	26.6%	34.6%	18.0%	22.6%	73.3%
3.5	27.6%	35.3%	19.0%	25.4%	75.9%
4.0	28.6%	36.9%	20.0%	28.2%	78.4%
4.5	29.3%	38.8%	21.0%	30.7%	79.1%
5.0	29.9%	40.6%	22.0%	33.1%	79.7%
5.5	35.6%	42.8%	23.0%	36.0%	80.3%
6.0	40.7%	44.9%	24.0%	38.9%	80.9%
6.5	41.8%	47.4%	25.0%	41.4%	81.4%
7.0	42.8%	49.9%	26.0%	43.9%	81.9%
7.5	43.4%	52.4%	28.4%	46.9%	81.9%
8.0	44.0%	54.8%	30.8%	49.8%	81.9%

DEPTH OF FLOOD	COMMERCIAL STR. 1-STORY	COMMERCIAL CONT. 1-STORY	MOBILE HOMES CONT.
-1	0	0	0
0	5.0%	0	3.3%
.5	7.0%	5.0%	15.0%
1.0	9.0%	10.0%	26.6%
1.5	11.5%	20.0%	37.9%
2.0	14.0%	30.0%	49.1%
2.5	16.0%	42.0%	56.6%
3.0	18.0%	54.0%	64.0%
3.5	20.0%	61.0%	66.8%
4.0	22.0%	68.0%	70.4%
4.5	24.0%	71.5%	73.0%
5.0	26.0%	75.0%	75.6%
5.5	28.5%	76.5%	76.6%
6.0	31.0%	78.0%	77.7%
6.5	33.0%	79.0%	78.3%
7.0	35.0%	80.0%	78.8%
7.5	37.5%	80.0%	79.8%
8.0	40.0%	80.0%	80.7%

TABLE 3

TOTAL DAMAGES SUMMARY
HUMBOLDT RIVER (NORTH, SOUTH AND TRIBUTARIES)
(October 1992 prices)
($1,000)

Land Use Category - Humboldt River, South Bank	33-year	100-year	500-year
Residential Structure/ Contents	1,245	2,134	2,509
Multi-Residential Structure/Contents	40	93	101
Mobile Home Structure/ Contents	690	2,934	7,712
Commercial Structure/ Contents	347	620	777
Public Structure/ Contents	458	691	910
Sheds	14	36	69
Emergency Costs	642	900	1,469
Road Damages	75	111	145
Auto Damages	143	662	1,109
Total	3,654	8,181	14,801

Land Use Category - Humboldt River, North Bank	166-year	500-year	-
Residential Structure/ Contents	1,230	1,524	
Multi-Residential Structure/Contents	34	60	
Mobile Home Structure/ Contents	1,645	1,733	
Commercial Structure/ Contents	3,800	5,587	
Public Structure/ Contents	0	0	
Sheds	7	9	
Emergency Costs	552	623	
Road Damages	89	99	
Auto Damages	389	467	
Total	7,746	10,102	

Land Use Category - Three Tributaries	50-year	100-year	500-year
Residential Structure/ Contents	96	570	1,250
Multi-Residential Structure/Contents	0	107	131
Mobile Home Structure/ Contents	0	12	1,026
Commercial Structure/ Contents	0	0	271
Public Structure/ Contents	11	17	520
Sheds	1	4	16
Emergency Costs	3	13	52
Road Damages	33	54	168
Auto Damages	3	32	161
Total	147	809	3,595

Tributaries nor the Humboldt River North flood plains would produce adequate benefits to make a project feasible. Thus, a more detailed analysis was not undertaken.

The flood damage reduction benefits for the Humboldt River South project are the difference between the average annual flood losses without the project and the residual average annual losses (damages) with the project.

b) Savings in Flood Insurance Administration Costs

Flood Insurance Administration Costs are the reduction in costs associated with the administration of the NFIP. The cost of servicing flood insurance policies includes the average cost per policy (including agents' commissions) and the costs of servicing and adjusting claims. The NFIP operating cost is currently $77 per policy. The Flood Insurance Administration costs benefits were $26,000 for the Humboldt River South. Since the Tributaries and Humboldt River North do not have a project, Flood Insurance Administration Costs were not estimated.

c) Recreation Benefits

Recreation development would be limited to the south side of the river due to the location of railroad tracks on the north side. Currently, there is no formal access or designated recreation use of the area. Suggested recreation facilities include a paved trail on the crown of the enlarged levee and a parking lot for five cars. Access to the area would be from the 12th Street end, at the pedestrian bridge, and at the downstream end of the enlarged levee. Total Average Annual Benefit of the proposed recreation recommendations amount to $34,000.

The proposed project consists of approximately .87 mile of levee with a pedestrian/bicycle trail. The standards for trail use for this type of trail are 90 people per mile of trail per day plus 10 percent. For this project, this is 87 visits per day. What follows is a calculation of average annual recreation benefits over the 50-year life of the project.

$$V = \frac{LxD}{PxE}$$

L = Design Load (100 x .87 per day)
D = Weekend Days per Month (9)
P = Percentage of Peak Month Use (Percent of Total Use) (.15)
E = Percent of Weekend Use (60 percent of use will be on weekends)

$$]V = \frac{87 \times 9}{.15 \times .60} = \frac{801}{.09} = 8{,}900 \text{ annual visits}$$

Using the Guidelines for Determining Point Values for General Recreation, 38 points were assigned for this project. The Conversion of Points to Dollar Value Table assigns a value of $3.81 per visit. Since it is anticipated that visitation will rise quickly and level off, the

average annual benefit for recreation can be quickly determined to be $33,909 (8,900 x $3.81) (rounded to $34,000).

VI. SUMMARY

The without-project damages for the Tributaries and Humboldt River (North and South) are presented in Table 4. The residual damages and the inundation reduction benefits for the Humboldt River South levee project are summarized in Table 5.

TABLE 4

AVERAGE ANNUAL DAMAGES
HUMBOLDT RIVER (NORTH, SOUTH, AND TRIBUTARIES)
(October 1992 prices, 1998-2048 @ 8-1/2 percent interest rate)
($1,000)

Category	Humboldt (North Bank)	Humboldt (South Bank)	Tributaries	Total
Residential	10.7	58.6	16.8	86.1
Multi-Residential	0.1	2.4	1.7	4.2
Mobile Home	13.1	95.1	5.4	113.6
Commercial	36.6	17.1	1.4	55.1
Public	0.0	20.2	3.4	23.67
Sheds	0.1	1.1	0.2	1.4
Emergency Costs	4.6	28.4	0.6	33.6
Roads Damages	0.7	3.2	3.1	7.0
Auto Damages	3.3	17.5	1.2	22.0
Total	69.2	243.6	33.8	346.6

TABLE 5

AVERAGE ANNUAL EQUIVALENT
DAMAGES AND BENEFITS
HUMBOLDT RIVER SOUTH
(October 1992 prices, 1998-2048 @ 8-1/2 percent interest rate)
($1,000)

Category	Without Project Damages	Levee With 100-Year Protection	
		Damages	Benefits
Residential	58.6	15.0	43.6
Multi-Residential	2.4	0.6	1.8
Mobile Home	95.1	46.3	48.8
Commercial	17.1	4.6	12.5
Public	20.2	5.5	14.7
Sheds	1.1	0.4	0.7
Emergency Costs	28.4	8.8	19.6
Road Damages	3.2	0.9	2.3
Auto Damages	17.5	6.7	10.8
Subtotal	243.6	88.8	154.8
Flood Insurance Administration Costs			13.0
Total	243.6	88.8	167.8

ATTACHMENT B

FEASIBILITY COST-SHARING AGREEMENT

FEASIBILITY COST-SHARING AGREEMENT
BETWEEN
THE UNITED STATES OF AMERICA
AND
THE CITY OF ELKO
FOR THE SECTION 205 FEASIBILITY STUDY
WASHOE VALLEY AT ELKO, NEVADA

THIS AGREEMENT, entered into this __nd day of _____, 19__, by and between the United States of America (hereinafter called the "GOVERNMENT"), represented by the Contracting Officer executing this Agreement, and The City of Elko, Nevada (hereinafter called the "Sponsor"),

WITNESSETH, that

WHEREAS, the Congress has authorized the Corps of Engineers to conduct studies of flood control pursuant to the continuing authority provided by Section 205 of the 1984 Flood Control Act, as amended (33 USC 701s), and

WHEREAS, the Corps of Engineers has conducted a preliminary study of flooding from the Humboldt River in the city of Elko, Nevada, pursuant to Section 205 of Public Law 80-858, hereinafter referred to as the "Reconnaissance Phase Study," pursuant to this authority, and has determined that further study in the nature of a "Feasibility Phase Study" (hereinafter called the "Study") is required to complete the determination of the extent of the Federal interest in participating in a solution to the identified problems[s]; and]

WHEREAS, the Sponsor has the authority and capability to furnish the cooperation hereinafter set forth and is willing to participate in study cost sharing and financing in accordance with the terms of this agreement; and

WHEREAS, the Sponsor and the Government both understand that entering into this agreement in no way obligates either party to implement a project and that whether a project is supported for authorization and budgeted for implementation depends upon the outcome of this feasibility study and whether the proposed solution is consistent with the Principles and Guidelines and with the budget priorities of the Administration, and that at the present time, favorable budget priority is being assigned to

projects providing primarily commercial navigation and flood or storm damage reduction outputs; and

WHEREAS, The Water Resources Development Act of 1986 (Public Law 99-662) specifies the cost-sharing requirements applicable to the study;

NOW THEREFORE, the parties agree as follows:

ARTICLE I - DEFINITIONS

For the purposes of this Agreement:

a. The term "Study Cost" shall mean all disbursements by the Government pursuant to this Agreement, whether from Federal appropriations or from funds made available to the Government by the Sponsor, and all Negotiated Costs of work performed by the Sponsor pursuant to this Agreement. Such costs shall include, but not be limited to: labor charges; direct costs; overhead expenses; supervision and administration costs; and contracts with third parties, including termination or suspension charges; and any termination or suspension costs (ordinarily defined as those costs necessary to terminate ongoing contracts or obligations and to properly safeguard the work already accomplished) associated with this Agreement.

b. The term "Study Period" shall mean the time period for conducting the Study, commencing with the issuance of initial Federal feasibility funds following the execution of this Agreement, and ending when the report is submitted to the Office of Management and Budget (OMB) by the Assistant Secretary of the Army for Civil Works (ASA(CW)) for review of consistency with the policies and programs of the President.

c. The term "Negotiated Cost" is the fixed fee for a work item to be accomplished by the Sponsor as in-kind services as specified in the Initial Project Management Plan incorporated herein and which is acceptable to both parties.

ARTICLE II - OBLIGATIONS OF PARTIES

a. The Sponsor and the Government, using funds contributed by the Sponsor and appropriated by the Congress, shall expeditiously prosecute and complete the Study, currently estimated to be completed in eighteen (18) months from the date of this Agreement, substantially in compliance with Article III herein and in conformity with applicable Federal laws and regulations, the Economic and Environmental Principles and Guidelines for Water and Related Land Resources Implementation

Studies, and mutually acceptable standards of engineering practice.

b. The Government and the Sponsor shall each contribute, in cash and in-kind services, fifty (50) percent of all Study Costs, which total cost is currently estimated to be $330,000, as specified in Article IV herein; provided, that the Sponsor may, consistent with applicable Federal statutes and regulations, contribute up to 25 percent of the Study Costs as in-kind services; provided further, the Government shall not obligate any cash contribution by the Sponsor toward Study Costs until such cash contribution has actually been made available to it by the Sponsor.

c. No Federal funds may be used to meet the local Sponsor share of study costs under this Agreement unless the expenditure of such funds is expressly authorized by statute as verified by the granting agency.

d. The award of any contract with a third party for services in furtherance of this Agreement which obligates Federal appropriations shall be exclusively within the control of the Government. The award of any contract by the Sponsor with a third party for services in furtherance of this Agreement which obligates funds of the Sponsor and does not obligate Federal appropriations shall be exclusively within the control of the Sponsor, but shall be subject to applicable Federal statutes and regulations.

e. The Government and the Sponsor shall each endeavor to assign the necessary resources to provide for the prompt and proper execution of the Study and shall, within the limits of law and regulation, conduct the study with maximum flexibility as directed by the Executive Committee as established by Article V, herein.

f. The Government will not continue with the Study if it determines that there is no solution in which there is a Federal interest or which is not in accord with current policies and budget priorities unless the Sponsor wishes to continue under the terms of this Agreement and the Department of Army grants an exception. If a study is discontinued, it shall be concluded according to Article XII, and all data and information shall be made available to both parties.

g. The Sponsor may wish to conclude the Study if it determines that there is no solution in which it has an interest or which is not in accord with its current policies and budget priorities. When such a case exists, the study shall be concluded according to Article XII, and all data and information shall be made available to both parties.

ARTICLE III - INITIAL PROJECT MANAGEMENT PLAN

Attachment C, the Initial Project Management Plan (IPMP), is hereby incorporated into this Agreement. The parties to this Agreement shall substantially comply with the Initial Project Management Plan in prosecuting work on the Study. The following modifications, to be approved by the Executive Committee, shall require an amendment to this Agreement:

a. any modification which increases the total Study Costs by more than 15 percent (Attachment C, Table 1);

b. any modification in the estimated cost of a Study work item or any obligation for a Study work item, which changes the total cost of that work item by more than 15 percent (Attachment C, Table 1);

c. any extension of the completion schedule for a Study work item of more than thirty (30) days;

d. any reassignment of work items between the Sponsor and the Government. (See Attachment C).

ARTICLE IV - METHOD OF PAYMENT

a. The Government shall endeavor to obtain during each fiscal year the appropriation for that fiscal year at least in the amounts specified in the Initial Project Management Plan incorporated herein. Subject to the enactment of Federal appropriations and the allotment of funds to the Contracting Officer, the Government shall then fund the Study at least in the amounts specified in the Initial Project Management Plan herein.

b. The Sponsor shall endeavor to obtain during each Government fiscal year the cash contribution for that Government fiscal year at least in the amounts specified in the Initial Project Management Plan incorporated herein and, once it has obtained funds for a cash contribution, shall make such funds available to the Government. The Government shall withdraw and disburse funds made available by the Sponsor subject to the provisions of this Agreement.

c. Funds made available by the Sponsor to the Government and not disbursed by the Government within a Government fiscal year shall be carried over and applied to the cash contribution for the succeeding Government fiscal year; provided, that upon study termination the excess cash contribution shall be reimbursed to the Sponsor after a final accounting, subject to the availability of appropriations, as specified in Article XII herein.

d. Should either party fail to obtain funds sufficient to make obligations or cash contributions or to incur Study Costs in accordance with the schedule included in the Initial Project Management Plan incorporated herein, it shall at once notify the Executive Committee established under Article V herein. The Executive Committee shall determine if the Agreement should be amended, suspended, or terminated under Article XII herein.

ARTICLE V - MANAGEMENT AND COORDINATION

a. Overall study management shall be the responsibility of an Executive Committee consisting of the District Engineer (or his designee) for the Sacramento District Corps of Engineers and Chief of the Planning Division for the Sacramento District Corps of Engineers. Representatives from the city of Elko will also be members of the Executive Committee.

b. To provide for consistent and effective communication and prosecution of the items in the Initial Project Management Plan, the Government and Sponsor shall appoint staff personnel to serve on a Study Management Team.

c. The Study Management Team will coordinate on all matters relating to prosecution of the Study and compliance with this Agreement, including cost estimates, schedules, prosecution of work elements, financial transactions and recommendations to the Executive Committee for termination, suspension, or amendment of this Agreement.

d. The Study Management Team will prepare quarterly reports on the progress of all work items for the Executive Committee.

ARTICLE VI - DISPUTES

a. The Study Management Team shall endeavor in good faith to negotiate the resolution of conflicts. Any dispute arising under this Agreement which is not disposed of by mutual consent shall be referred to the Executive Committee. The Executive Committee shall resolve such conflicts or determine a mutually agreeable process for reaching resolution or for termination under Article XII herein.

b. Pending final decision of a dispute hereunder, or pending suspension or termination of this Agreement under Article XII herein, the parties hereto shall proceed diligently with the performance of this Agreement.

ARTICLE VII - MAINTENANCE OF RECORDS

The Government and the Sponsor shall keep books, records, documents and other evidence pertaining to study costs and expenses incurred pursuant to this Agreement to the extent and in such detail as will properly reflect total Study costs. The Government and the Sponsor shall maintain such books, records, documents and other evidence for inspection and audit by authorized representatives of the parties to this Agreement. Such material shall remain available for review for a period of three (3) years following the termination of this Agreement.

ARTICLE VIII - RELATIONSHIP OF PARTIES

a. The parties to this Agreement act in an independent capacity in the performance of their respective functions under this Agreement, and neither party is to be considered the officer, agent, or employee of the other.

b. To the extent permitted by applicable law, any reports, documents, data, findings, conclusions, or recommendations pertaining to the Study shall not be released outside the Executive Committee or the Study Management Team; nor shall they be represented as presenting the views of either party unless both parties shall indicate agreement thereto in writing.

ARTICLE IX - OFFICIALS NOT TO BENEFIT

No member of or delegate to the Congress, or other elected official, shall be admitted to any share or part of this Agreement, or to any benefit that may arise therefrom.

ARTICLE X - FEDERAL AND STATE LAWS

In acting under its rights and obligations hereunder, the local Sponsor agrees to comply with all applicable Federal and State laws and regulations, including section 601 of Title VI of the Civil Rights Act of 1964 (Public Law 88-352) and Department of Defense Directive 5500.II issued pursuant thereto and published in Part 300 of Title 32, Code of Federal Regulations, as well as Army Regulation 600-7, entitled "Nondiscrimination on the Basis of Handicap in Programs and Activities Assisted or Conducted by the Department of the Army."

ARTICLE XI - COVENANT AGAINST CONTINGENT FEES

The Sponsor warrants that no person or selling agency has been employed or retained to solicit or secure this Agreement upon

agreement or understanding for a commission, percentage, brokerage, or contingent fee, excepting bona fide employees or bona fide established commercial or selling agencies maintained by the non-Federal Sponsor for the purpose of securing business. For breach or violation of this warranty, the Government shall have the right to annul this Agreement without liability, or, in its discretion, to add to the Agreement or consideration, or otherwise recover, the full amount of such commission, percentage, brokerage, or contingent fee.

ARTICLE XII - TERMINATION OR SUSPENSION

a. This Agreement shall terminate at the completion of the Study Period; provided, that prior to such time and upon thirty (30) days written notice, either party may terminate or suspend this Agreement without penalty.

b. Within ninety (90) days upon termination of this Agreement, the Study Management Team shall prepare a final accounting of Study Costs, which shall display disbursements by the Government of Federal funds, cash contributions by the Sponsor, and credits for the Negotiated Costs of the Sponsor. Subject to the availability of funds, within thirty (30) days thereafter the Government shall reimburse the Sponsor for the excess, if any, of cash contributions and credits given over fifty (50) percent of total Study Costs. Within thirty (30) days thereafter, the Sponsor shall provide the Government any cash contributions required so that the total Sponsor share equals fifty (50) percent of total Study Costs.

IN WITNESS WHEREOF, the parties hereto have executed this Agreement as of the day and year first above written.

THE UNITED STATES OF AMERICA

BY

_____

Laurence R. Sadoff, Colonel
District Engineer, Sacramento
Corps of Engineers
Contracting Officer

STUDY SPONSOR

BY

_____

ATTACHMENT C - INITIAL PROJECT MANAGEMENT PLAN

ATTACHMENT C

INITIAL PROJECT MANAGEMENT PLAN

ATTACHMENT C

INITIAL PROJECT MANAGEMENT PLAN

PURPOSE AND SCOPE

The purpose of this Initial Project Management Plan (IPMP) is to identify the work items, cost, and completion schedules for the feasibility phase of the Washoe Valley at Elko, Nevada. The result of this phase will be a Detailed Project Report (DPR) that may recommend a water resources plan for implementation. In order to clarify cost-sharing responsibilities, the study obligations of the Corps of Engineers (referenced as "The Government" in Agreement) and the Sponsor, the City of Elko, are also identified in accordance with the Water Resources Development Act of 1986 (WRDA of 1986).

DESCRIPTION OF STUDY AREA

The overall study area is the City of Elko, Nevada, and vicinity. The primary study area is within the city extending along the Humboldt River from just upstream of the 12th Street bridge to downstream of the Bullion bridge. Elko is located in the northeastern portion of Nevada in west-central Elko County, about 289 miles northeast of Reno.

FEASIBILITY STUDY COORDINATION

The feasibility study will be managed by an Executive Committee and a Study Management Team as provided by Article V of the Agreement. The Executive Committee will manage the overall study by (1) maintaining a working knowledge of the feasibility study, (2) assisting in resolving emerging policy issues, (3) assuring that evolving study results and policies are consistent and coordinated, (4) directing the Study Management Team, and (5) ratifying decisions made by the Study Management Team.

The Study Management Team will be lead by the Corps technical study manager and include personnel or support appropriate from the Corps and staff from the Sponsor. It may also include representatives from other Federal, State, and local agencies, interested organizations, and individuals. The Study Management Team will oversee the study to ensure the establishment of desired mutual roles, interests, and study objectives.

PLANS FOR FUTURE STUDY

Reconnaissance studies identified a serious flood threat to Elko primarily along the south side of the Humboldt River. The study also identified the need for additional incidental recreation opportunities in the area. Measures to help resolve this flood problem and increase recreation opportunities were defined and evaluated. Potential feasible alternatives were identified. All measures and alternatives identified in the reconnaissance study will be reported on in the DPR. In addition, plans to maximize net economic development (NED) and nonstructural will be developed. Based on the results of the reconnaissance phase and input from the Sponsor, alternatives that will be considered in feasibility studies include upgrading the levee along the south bank of the Humboldt River and a recreation trail system associated with the levee upgrade. It is anticipated that a plan similar to that in the reconnaissance report, but providing a 50-, 100-, and 150-year level of flood protection, will be evaluated.

WORK TASKS AND RESPONSIBILITIES

Feasibility studies will focus on formulating and evaluating the best alternative for implementation. The following is a brief description of the major feasibility phase tasks and the responsibilities for accomplishment of these tasks. At the beginning of each task, the non-initiating agency, either Corps or Sponsor, may review any planned in-kind work or contract of the other for adequacy. At the conclusion of each task, the non-initiating agency may review and approve the results of the work before it is considered complete. Review and assessment of the adequacy of the task will be accomplished by the Study Management Team and its technical staff. The major study tasks and their expected costs are summarized in Table 1.

Public Involvement

Responsibility for this task will be shared between the Corps and the Sponsor. This task will include conducting at least one public meeting and responding to public inquiries. It likely will also include meetings with special interest groups.

Institutional Studies

This task will be accomplished by the Corps and primarily consists of determining the financial and legal arrangements required to implement the recommended plan, including methods of financing. A financial capability analysis will examine whether the potential Sponsor for construction has the organizational, legal, and financial capability to undertake the required financial obligations for implementation of the project. Studies

include determining the political institutional arrangements of the study area and identifying attitudes and customs regarding the management and use of the resources. The results of the study will be provided in a financial and cost recovery analysis section of the DPR.

Cultural Resources Studies

The cultural resources studies to be performed by the Corps will determine the impacts of the alternative plans on any historical, architectural, and archeological resources in the construction area. A field survey to locate cultural sites, in accordance with the National Historic Preservation Act of 1966, may need to be performed. A report to document the survey results, outline significant cultural resources, and describe impacts of each alternative on cultural resources will be prepared and coordinated with the State Historic Preservation Officer, the National Park Service, and the Advisory Council on Historic Preservation. Any sites discovered during the survey will be evaluated for the National Register of Historic Places.

Environmental/Recreation Studies

The Environmental Evaluation prepared in the reconnaissance phase will be expanded by the Corps into a comprehensive Environmental Assessment (EA) and Finding of No Significant Impact (FONSI) or a determination that an EIS is required. The EA will evaluate the environmental effects of the alternative plans. The Draft EA will be circulated to appropriate State and Federal agencies and interested organizations and individuals. Comments received on the draft will be addressed and the document revised as appropriate. The final EA/FONSI or notice of intent will be prepared based on the agency and public comments.

Mitigation features for fish and wildlife and other affected resources will be refined and a monitoring program developed to record the success of the mitigation measures. Any land required for mitigation will be identified.

Requirements of Section 7 of the Endangered Species Act will be completed during feasibility. A biological assessment and formal consultation with the U.S. Fish and Wildlife Service (FWS) and the Nevada Department of Wildlife will be initiated if it is determined that endangered species will be affected by the alternatives.

A Section 404(b)(1) evaluation of water quality impacts will be accomplished and coordinated with State and Federal water quality agencies to ensure adequate consideration had been given to water quality and to acquire water quality certification or exemption.

A recreation use and demand study will be conducted to determine the recreation needs of the Elko area. If the results of this study indicate a demand for recreation, a cost-sharing sponsor will be identified for facility development to meet the demand.

Fish and Wildlife Studies

This task includes studies conducted by the FWS in support of the above-mentioned Environmental Studies by agreement with the Corps as required by the Fish and Wildlife Coordination Act. A brief FWS Planning Aid Letter will be prepared that will refine environmental effects of the alternatives, summarize other study findings, and recommend types and amounts of mitigation for habitat losses.

Economic Studies

This task will be accomplished by the Corps. It will consist of reviewing and reevaluating flood damages, flood damage reduction benefits, and potential benefits associated with other incidental purposes. The amount of flood-damageable property estimated in the reconnaissance report will be supplemented with updated information if appropriate. A computer model that helps define the relationships between damageable property and flood events will be refined to develop feasibility-level estimates of average annual flood damages that occur with and without the proposed plans. Transportation information, emergency cost savings, and impact of the recommended plan on Federal Emergency Management Agency requirements will be included in this estimate. An estimate of foundation heights and structural characteristics will be included in the study along with a specific land use analysis.

These studies will assist in measuring flood control benefits for the alternative plans to be developed (see plan formulation) and selecting a project for recommended implementation. An economic report will be provided for inclusion in the technical documentation for the feasibility study.

Hydrology Studies

This task will be accomplished by the Corps. This work item will include upgrading hydrology used for the reconnaissance report and will be consistent with the new guidance on "Risk Analysis for Flood Damage Reduction Studies." The existing all-events flow-frequency curve for the Humboldt River at Elko, Nevada, developed during the reconnaissance studies will be updated to include confidence limits. The 1-day, 3-day, and 7-day volume frequency curves will be developed. Also, hydrographs for the 50-, 100-, and 150-year events on the Humboldt will be

generated. During the reconnaissance study, culverts were determined to be used to prevent increased ponding damages from the southside tributary streams. Hydrographs and associated routing will be developed to provide data to design and size the required culverts for the 50-, 100-, and 150-year and the selected plan. A feasibility-level hydrology report will be generated.

Flood Plain Review

This task will be accomplished by the Corps using available mapping and cross sections. This task will include reviewing information in the reconnaissance study and revising this as appropriate.

Basis Of Design

This task will be accomplished by the Corps. The basis of design shall be prepared in accordance with ER 1110-2-265, Engineering and Design Studies. This task includes the design of the levee and recreation trail; preparation of plates and figures displaying the plan, profile, and typical cross sections; field investigations and coordination with local sponsor and other Corps elements regarding design considerations; development of all quantities for preparation of cost estimates; construction and advance design scheduling; and preparation and reproduction of narrative report documenting all technical studies.

Hazardous and Toxic Waste

No hazardous and toxic waste (HTW) problems have been identified in the reconnaissance assessment, nor have any further studies been included in the feasibility study cost estimate. However, if HTW problems are encountered during feasibility-phase investigations, a response analysis shall be initiated to identify and evaluate alternatives to respond to the verified problem. The first alternative shall be avoidance of the problem area. Activities conducted to address the HTW problem could include sampling and analysis to identify contaminants and concentrations, delineation of site contamination, assessment of threat to human health and the environment, cost analysis of response costs, and adherence to environmental standards and criteria. This feasibility study shall be cost shared; accordingly, the analysis and design of HTW response measures is the responsibility of the non-Federal sponsor and will be completed by the sponsor.

Cost Estimating

This task will be performed by the Corps. Cost Engineering Branch will determine the "Baseline" cost estimate for the proposed project, determine interest during construction, and

develop narrative of basis of estimate. An MCACES cost estimate shall be prepared for project first and annual and operations costs.

Hydraulic Design

This task shall be performed by the Corps. The feasibility study shall develop the preproject and postproject backwater curves based on the surveyed cross sections and feasibility-level hydrology. Risk framework analysis, interior drainage, and sediment transport issues shall be addressed. Impacts due to the raising of the water-surface elevation will be addressed for areas within, upstream, and downstream of the project reach. Impacts of events exceeding the design event shall be evaluated. Streambank stabilization and channel stability shall be addressed. This task is to develop design water-surface profiles and top-of-levee elevations.

Surveys

This task will be accomplished by the Sponsor and the Corps. The Sponsor will do the majority of the work with the Corps having responsibility to assure that the required surveys conform to Corps requirements. For feasibility-level studies, accurate ground data and survey control need to be provided. Surveys will include cross sections at 50-foot intervals along the alignment, covering about 100 feet east of the landside toe of the levee and 100 feet or more west from the levee on the waterside of the levee. The cross sections shall commence approximately 100 feet upstream (through the 12th Street bridge) and be complete approximately 100 feet downstream of the project reach. At 500-foot intervals, the waterside cross section shall be extended across the river. The cross sections are to be 1,000 feet upstream and downstream of the study reach. Aerial surveys could be used, tolerances not to exceed one-quarter foot plus or minus.

Soils/Geology

This task shall be accomplished by the Corps and include developing levee design cross sections and soil material requirements. This task also includes field explorations consisting of 10 rotary drill holes through the existing left levees of the Humboldt River and 3 to 4 backhoe pits in each of three potential levee borrow sources. Drilling will be by hollow-stem auger with "continuous" Standard Penetration Testing. Laboratory testing will be conducted at the South Pacific Division laboratory in Sausalito, California. Primary testing will consist of soil classification, particle-size analysis, and plasticity characteristics. Soils Design Section and Geology Section shall prepare a narrative report suitable for incorporation into the Basis of Design report. It is anticipated that the drilling will be contracted out to a local driller.

Real Estate Studies

This task will be accomplished by the Corps. During the feasibility studies, the Corps Real Estate Division will be the responsible agency for the project real estate requirements and shall be responsible for the preparation of a Gross Appraisal, detailing the value of all project lands and relocation costs under Public Law 91-646. A Real Estate Map will be prepared, detailing the real estate requirements for the selected project, including any mitigation which is determined necessary. Rights-of-entry will be obtained as may be necessary for cultural, environmental, and engineering surveys.

The Real Estate Division shall also prepare a Real Estate Supplement, which shall identify all real estate requirements for the project and contain the baseline cost estimate and acquisition schedule. The Sponsor will determine acquisition costs, and the Corps will incorporate that information into the real estate portion of the Code of Accounts, which the Corps will prepare. All real estate work will be performed in accordance with ER 405-1-12 and EC 405-2-14. All costs, including acquisition and administrative costs, will be identified in the MCACES Code of Accounts format as required by EC 1110-2-586.

Study Management

This task will be accomplished by the Corps in coordination with the Sponsor. It will include all activities related to study management, such as study scheduling, providing detailed information for the work done by others, monitoring and modifying assigned work items as required, reviewing results and reports provided by the technical support staff, and coordinating with other Corps offices. Budget preparation, correspondence, interorganizational coordination, and point-of-contact responsibilities are also part of the management program. Periodic meetings will be held between the Corps and the Sponsor to report on the status of the study and possible in-kind services, and monthly status reports and financial monitoring will be provided by the Corps. Assistance and technical studies and technical coordination will also be provided. The general direction and condition of the study will be managed and monitored at all times.

Study management will ensure that all required tasks and coordination are performed. The study management structure developed during the reconnaissance phase will continue into the feasibility phase and include coordination efforts associated with the Study Management Team and Executive Committee.

Plan Formulation

This task will be accomplished by the Corps and coordinated closely with the Sponsor. This task includes reviewing and refining the plans selected for study during the feasibility phase and other plans formulated to date, and developing required alternatives such as a no-action plan, a nonstructural plan, and plans for 50-, 100-, and 150-year levels of protection. This task also includes identifying the NED plan, considering environmental impacts and the views of the public, and including appropriate mitigation measures into the plans. The costs and benefits associated with each plan will be determined, and trade-offs required to select the recommended plan for implementation will be identified.

The annual and periodic activities and responsibilities for operating and maintaining the completed project will be described and closely coordinated with other requirements (e.g., cost estimates and environmental monitoring). The magnitude of these activities will be described for the alternative recommended for implementation. All requirements of 33 CFR 208 and other Federal regulations specifying operation and maintenance requirements will be clearly described so that the Sponsor's future duties will be known.

Report Preparation

This task will be the responsibility of the Corps in coordination with the Sponsor. The work will include assembling pertinent data, writing, editing, typing, drafting, reviewing, revising, reproducing, and distributing the draft and final feasibility reports, environmental document, and related technical documents.

This task also includes work items necessary to process the DPR to higher Corps authority and receipt of approval for continuing into the construction phase.

Review Contingency

This item covers possible requirements for additional rewriting, some reformulation, or documentation as a result of review by higher authority. Any costs that are incurred after the end of the feasibility phase will be 100 percent Federal.

FEASIBILITY STUDY COST ESTIMATE

The study cost estimate for the feasibility-phase is $330,000. (See Table 1.) All feasibility-phase study costs are required to be cost shared between the Corps and the Sponsor on a 50-50 basis. Further, the Sponsor will provide, as a minimum,

half of its share as a cash contribution. Table 1 outlines tasks to be performed, estimated cost of each task, and study obligations for the Corps and the Sponsor.

The cost estimate for the feasibility study will be separated into appropriate quarters. Table 2 outlines the cost for each quarterly period during the feasibility phase. It assumes the feasibility phase will be initiated in the fourth quarter of FY-1993, when cost-sharing funds become available. The Corps will provide periodic reports to the Sponsor, which would include "Selective F&A Data Base Record, Form 666." The Sponsor will provide the Corps, on a quarterly basis, similar finance and accounting data that would record the work-in-kind efforts by the Sponsor. The value of the in-kind services will be based on the equivalent Government cost.

FEASIBILITY STUDY SCHEDULE

The final DPR is scheduled to be submitted to the South Pacific Division in about 18 months after the signing of the FCSA. A schedule of major tasks is shown on Table 3.

COORDINATION MECHANISM BETWEEN THE CORPS AND SPONSOR

The Executive Committee (or the Committee's representatives) is scheduled to meet, at a minimum, at the signing of the FCSA, at the Public Meeting, and at the concluding Issue Resolution Conference (IRC). The Committee will also meet periodically to discuss the project status and to handle changes in study scope that would result in an increase in total study cost or major changes in study direction, and at additional IRCs, if necessary. The Study Management Team will meet as appropriate.

Financial coordination will include quarterly financial statements composed of expenditures and obligations. The Corps will also provide quarterly reports to the Sponsor, which would include "Selective F&A Data Base Record, Form 666." The Sponsor will provide the Corps, on a quarterly basis, similar finance and accounting data that will record cash expenditures and work-in-kind efforts by the Sponsor and the Sponsor's associates. Cost-sharing cash payments will be made to the Corps on or about October 1, 1993; January 1, 1994; April 1, 1994; July 1, 1994; October 1, 1994; and January 1, 1995. A final reconciliation of the cost-sharing cash payment will be made at the conclusion of the study. The Corps will also furnish to the Sponsor progress reports.

TABLE 1

FEASIBILITY STUDY COST ESTIMATE

TASK	FEDERAL	NON-FEDERAL	TOTAL
PUBLIC INVOLVEMENT	1,000	1,000	2,000
INSTITUTIONAL STUDIES	2,000	0	2,000
CULTURAL RESOURCES	6,000	0	6,000
ENVIRONMENTAL/RECREATION STUDIES	27,000	0	27,000
FISH & WILDLIFE STUDIES	9,000	0	9,000
ECONOMIC STUDIES	17,000	0	17,000
HYDROLOGY STUDIES	30,000	0	30,000
FLOOD PLAIN REVIEW	8,000	0	8,000
BASIS OF DESIGN	25,000	0	25,000
COST ENGINEERING	15,000	0	15,000
HYDRAULIC DESIGN	41,000	0	41,000
SURVEYS	5,000	25,000	30,000
SOILS/GEOLOGY	37,000	0	37,000
REAL ESTATE STUDIES	30,000	0	30,000
STUDY MANAGEMENT	8,000	3,000	11,000
PLAN FORMULATION	10,000	0	10,000
REPORT PREPARATION	20,000	0	20,000
REVIEW CONTINGENCY	10,000	0	10,000
TOTAL	301,000	29,000	330,000
CASH ADJUSTMENT	(136,000)	136,000	0
50% OF STUDY COST	165,000	165,000	330,000

TABLE 2

FEASIBILITY COST BY QUARTER
(in $1,000)

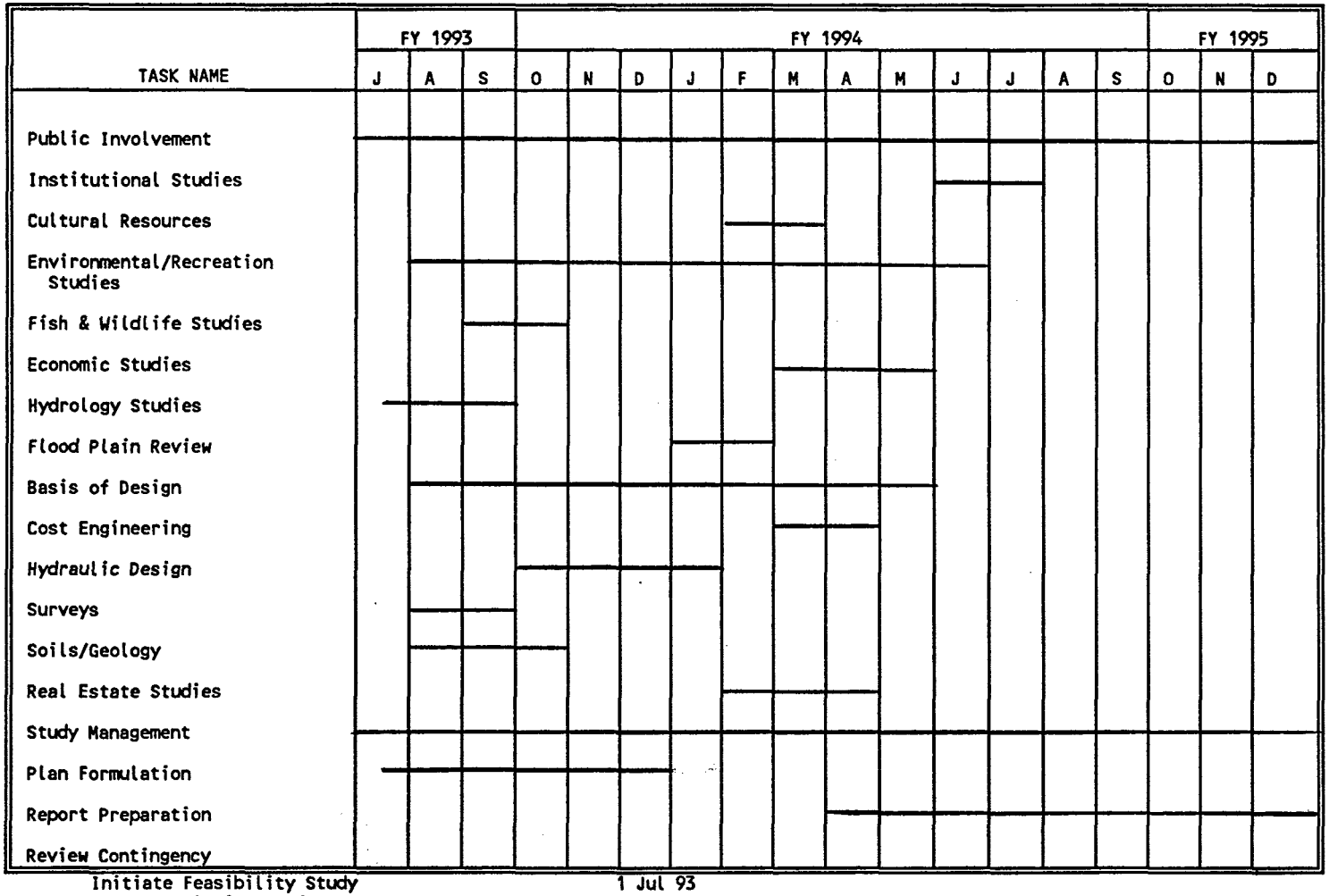
Task	Fiscal Year						Task Total
	1993	1994				1995	
	4th	1st	2d	3d	4th	1st	
Public Involvement [1]	0.6	0.4	0.2	0.2	0.2	0.4	2.0
Institutional Studies				1.0	1.0		2.0
Cultural Resources			4.0 2.0C				6.0
Environmental/ Recreational Studies	6.0	6.0	7.0	8.0			27.0
Fish & Wildlife Studies (C) [2]	0.5 1.0C	0.5 7.0C					9.0
Economic Studies			6.0	11.0			17.0
Hydrology Studies	30.0						30.0
Flood Plain Review			8.0				8.0
Basis of Design	4.0	4.0	11.0	6.0			25.0
Cost Engineering			7.0	8.0			15.0
Hydraulic Design		30.0	11.0				41.0
Surveys	30.0						30.0
Soils/Geology	14.0 10.0C	7.0 6.0C					37.0
Real Estate Studies			20.0	10.0			30.0
Study Management	2.0	1.0	2.0	2.0	2.0	2.0	11.0
Plan Formulation	4.0	6.0					10.0
Report Preparation				6.0	10.0	4.0	20.0
Review Contingency					5.0	5.0	10.0
TOTAL							
Labor	91.1	54.9	76.2	52.2	18.2	11.4	304.0
Contracts	11.0	13.0	2.0	-	-	-	26.0
Total	102.1	67.9	78.2	52.2	18.2	11.4	330.0
Federal	51.05	33.95	39.1	26.1	9.1	5.7	165.0
Non-Federal							
In-Kind	26.0	0.5	0.6	0.6	0.6	0.7	29.0
Cash	25.05	33.45	38.5	25.5	8.5	5.0	136.0
Year Total	102.1				216.5	11.4	
Federal	51.05				108.25	5.7	
Non-Federal							
In-Kind	26.0				2.3	0.7	
Cash	25.05				105.95	5.0	

[1] Except where noted, costs are for total labor and include an allowance for indirect and overhead.

[2] C= Contract.

TABLE 3

SCHEDULE



Initiate Feasibility Study	1 Jul 93
Issue Resolution Conference	
District Submit DRaft DPR	30 Sep 94
Field Level Coordination	28 Oct 94
Public Meeting	30 Nov 94
District Submit Final DPR	30 Dec 94

ATTACHMENT D

OFFICE REPORT
BASIS OF DESIGN AND COST ESTIMATES

September 1992

WASHOE VALLEY, NEVADA at ELKO

OFFICE REPORT

BASIS OF DESIGN AND COST ESTIMATES

SEPTEMBER 1992

U.S. ARMY CORPS OF ENGINEERS
CIVIL PROJECTS BRANCH
SACRAMENTO DISTRICT

PERTINENT DATA

GENERAL DATA

River	Humboldt
Purpose	Flood Control
Drainage Area at Study Reach	2,774 sguare miles

LEVEE ENLARGEMENT

Project Levees

Rebuild levee	750 feet
Enlarge levee	3860 feet
New levee	820 feet
Total	5430 feet

Avg. height

Existing levee (left bank)	
Sta. 0+00 to 23+00	5 to 7 feet
Sta. 23+00 to 46+10	3 to 4 feet
Enlarged levee (left bank)	
Sta. 0+00 to 23+00	7 to 8 feet
Sta. 23+00 to 46+10	4 feet
New levee (46+10 to 54+30)	3 feet

Crown width	minimum of 12 feet
Slope, waterside and landside	1V on 3H (minimum)
Freeboard	3 feet 4 feet (100 feet u/s and d/s of bridge crossings)
Riprap	21 inch, approx. 1000 feet

INTERIOR DRAINAGE

Conduits	5
Diameter	4-36 in., 1-24 in.
Length, average	80 feet

DETENTION BASIN- alternative to interior drainage conduits

	15 AF
Dam height, ft.	15
Dam width, ft.	180
Outlet, uncontrolled	48 inch

RECREATION

Scope	Bike Trail and Parking Area
Length, ft.	4800
Width, ft.	10
Access Points	3
Parking, gravel	5 cars (approx. 1500 sf.) with 100 ft access road

WASHOE VALLEY, NEVADA at ELKO

BASIS OF DESIGN AND COST ESTIMATES

OFFICE REPORT

SEPT 1992

TABLE OF CONTENTS

FIGURES

PHOTOS

ATTACHMENTS

WASHOE VALLEY, NEVADA AT ELKO

BASIS OF DESIGN AND COST ESTIMATES

OFFICE REPORT

SEPTEMBER 1992

1. Authorization.- This study was prepared as requested by Sacramento District, Planning Division, Colorado/Great Basin Branch, under Work Order Request AA177-92-2, dated 10 Jan 1992, revised 11 Mar 1992.

2. Purpose and Scope.- The purpose of this office report is to summarize the engineering studies performed to support plan formulation of reconnaissance level studies of the subject area.

3. Project Location and Description of Proposed Plan.- The study area lies within the City limits of Elko, Nevada. The City of Elko is located in north-central Nevada (see Figure 1). The study plan of improvement includes enlargement of the existing levee (approximately 4600 lineal feet), construction of interior drainage features (drainage conduits with excavated inlet, through the levee) and a new tie-back levee to high ground (approximately 820 feet in length) at the downstream limit of the enlarged levee section. As a cost comparison alternative to the drainage conduits a flood detention basin, dry dam, was considered along Panorama Wash just upstream of the Lemoille Highway (see Figure 3). The objective level of flood protection used for this office study was the 100-year flood frequency event.

4. Study Area Background.- In 1981, a construction project, "Project Lifesaver", was undertaken to relocate two railroad lines within the city of Elko, Nevada. The lines were moved southwest of the center of the city. This relocation required the straightening of the Humboldt River for approximately one mile to accommodate this relocation. The new railroad embankment now serves as the existing right bank levee. An eight foot soundwall was also constructed to the landside of (to both sides of the railroad tracks between the 12th Street bridge and the pedestrian bridge) and at the crest of the railroad embankment. A new left bank levee was also constructed as part of this project. Figure 4 displays typical existing cross sections.

5. Design Considerations.-

5.1 Drainage Area and Topography.- The Humboldt River Basin has an area of approximately 16,700 square miles between the Sierra Nevada and Rocky Mountains in north-central Nevada. The Humboldt River originates in the Ruby Mountains at over 11,000 feet above mean sea level (m.s.l.). The river flows southwesterly through steep canyons and broad flood plains and terminates at the Humboldt Sink, about 3,900 feet above m.s.l.. Upstream of Elko, Nevada, the drainage area is 2,774 square miles. The City of Elko is situated at approximately 5100 feet above m.s.l.. The terrain of the developed area of the city is flat. Just to the north and south of the city, the terrain steeply rises into the adjacent foothills, to approximately 5900 to 6400 feet above m.s.l. The southern edge of the city is subject to flooding from rainfall generated runoff from three washes, Southside, Panorama and Metzler. A small detention basin on Southside Wash has been constructed by the Soil Conservation Service (date of service unknown). The runoff from the washes are collected by the city's existing underground drainage system by drop inlets(with trash racks) and conduits located just upstream of the Lemoille Highway and passed underneath the existing south levee. The flow from the Southside detention basin is passed by a 60 inch conduit, the outlet located just downstream of the 5th Street bridge crossing, the Panorama Wash runoff is passed by a 48 inch conduit, the outlet located just upstream of the pedestrian bridge crossing and a portion of the Metzler Wash runoff is passed by an existing drainage channel and two-36 inch conduits located just downstream of the 12th Street bridge crossing.

5.2 Hydrology.- A reconnaissance level hydrology study was conducted by the Sacramento District, Civil Projects Branch, Hydrology Section, in November 1991. The hydrology office report is enclosed as Attachment One to this report. The peak flows, in cubic feet per second, for various frequencies for the Humboldt River near Elko, Nevada, were concluded to be as follows:

	500-year	100-year	50-year	10-year
Rainfall	28,300	11,500	6,190	2,530
Snowmelt	8,710	6,190	5,210	3,140
All events	28,400	12,100	8,580	4,000

The 100 year runoff peak flows (generated by cloudburst rainfall event), in cubic feet per second, for the left bank tributary inflows were as follows:

	100-year peak flows in cfs
Metzler Wash	700
Southside Wash	500
Panorama Wash	320

One hundred year snowmelt peak flows were evaluated for the tributaries and were as follows:

	100-year peak snowmelt flows in cfs
Metzler Wash	40
Southside Wash	25
Panorama Wash	15

5.3 Hydraulic Design.- Water surface profiles were developed by Sacramento District, Planning Division, Colorado/Great Basin Branch. A summary of the water profile studies follows.

5.3.1 Water Surface Profiles.- The current version of the HEC-2 computer program, "Water Surface Profiles" (September 1988, Error Corrections 01,02,03) was used to compute the project design water surface profiles. A HEC-2 data set was developed in order to simulate pre-project and post-project conditions for the 33 year to 500 year events. Manning's "n" roughness values from previous studies and/or observations in the field were used to evaluate the friction losses. The flow regime in the project channels will be subcritical. To be conservative, loss coefficients for transition losses were 0.5 for expansion and 0.3 for contractions. Bridge losses were computed in the HEC-2 backwater run with the Standard Step method.

The project reach was analyzed using cross sections from aerial data developed by Nimbus Engineers for FEMA (1991). The cross section interval was determined through consultation with Flood Plain Management Section. The interval varies;however, is an average of 600 feet. Figure 5 displays the computed 100 year water surface profile, left and right bank elevations and elevation of the enlarged/new levee. Water surface elevations for the 500 year event would be approximately 3 feet above the 100 year water surface elevations.

5.3.2 Roughness Factors.- The Manning's "n" values used in determining water surface stages varied horizontally along each cross section. In the overbank area subject to flooding, "n" value of 0.05 was used. In the channel bottom and channel bank areas, "n" values of 0.035 and 0.04 were used respectively.

5.3.3 Starting Water Surface Elevations.- Starting water surface elevations for the pre-project HEC-2 model were based on data computed by FEMA for the approximate high water marks for the 1984 flood event (flow approximately 7,200 cfs).

5.3.3 Erosion and Sedimentation.- No major sediment transport or associated problems are indicated in the Humboldt River immediately upstream, downstream, or within the project reach. The raising of the levees should not have any effect on the sediment transport capacity of the river. Due to the presence of loose, cohesiveless soils along the river bank, the potential for erosion problems exist;however, visual survey of the study reach did not reveal any major problems.

5.3.4 Induced Flooding.- There would be no induced flooding due to the levee enlargement for postproject conditions over and above preproject conditions. However, drainage features are required to prevent additional ponding, in duration, behind the existing south levee up to the 100 year event along the Humboldt River tributaries. Interior drainage would be controlled by the construction of either upstream detention basin along Panorama Wash or the installation of drainage conduits through the enlarged left bank levee, the least costly measure to be used. Preliminary computations indicate that approximately 15 acre-feet of runoff would have to be controlled on Panorama Wash to prevent higher interior flooding stages under postproject along In order to pass the additional ponded storage during the 100 year event the drainage conduit system would be required to pass approximately 100 cfs over a 3-4 hour period during the 100 year peak cloudburst event. The system would be comprised of five conduits, four of 36 inch diameter located as follows; three just downstream of the 12th Street bridge, one between the pedestrian bridge and 5th Street bridge and a 24 inch conduit through the tie-back levee. The location of these conduits is based on the drainage patterns of the existing topography. The installation of the conduits should not aggravate existing drainage operation as the event that tributary runoff is significant is discrete from the high stage in the Humboldt River. The peak flow event in the Humboldt River is due to a combination snowmelt and rainfall, while the tributary peak flow event is due to rainstorm cloudburst.

5.3.5 Impacts of Events Exceeding the Design Event.- Overtopping design considerations will be included in further design stages; however, initial overtopping for floods larger than the design flood could occur at a section approximately 100 feet downstream of the 12th Street bridge. This would minimize flood damages to the adjacent area due to the minimal development. Conservative freeboard recommendation of three feet (four feet, 100 feet upstream and downstream of bridges) has been used in this reconnaissance level design. For events exceeding the design event, due to the wide floodway, increases in stages in the Humboldt River over preproject conditions will be insignificant.

5.4 Geotechnical.- Site visits to the area were conducted in October 1991 and March 1992. The purpose of the visits were to field inspect the area, evaluate the condition of the existing levees and locate potential borrow sources. The Sacramento District, Geotechnical Branch, office reports for the field reconnaissance are included in this office report as Attachment Two. A brief summary of the office reports follow.

5.4.1 Field Observations.- The existing levee system was inspected in October 1991 and March 1992. The existing left bank levee from just downstream of the 12th street bridge for about 800 feet is inadequate to contain high flows. The cross section is narrow, characterized by a top width of 8 to 10 feet and side slopes which nearly appear to be 1V on 1H (see Photo One). The levee height ranges from 6 to 7 feet. The levee material as observed on the surface is predominantly silt with small amounts (10 to 20 percent) of fine sand. Some parts of the reach also contained fine gravel. Fine grained, cohesiveless soils such as these are highly erodible and with the steep slopes and narrow cross section, this area is highly susceptible to seepage and possible failure due to piping or sloughing during high flood flows. A layer of ungraded riprap (original design drawings called for a 21 inch layer) is present on the riverside slope, approximately 4 feet below the crown. There is evidence this reach of the levee is uncompacted. There is a critically low section approximately 80 to 100 feet downstream of the 12th street bridge (see Photo Two) . This crown elevation was determined to be three feet lower than the adjacent crown elevation by a quick survey effort conducted by the city of Elko. The grade loss may be due to settlement or possibly overuse by foot traffic, bicycle traffic, etc. gaining access to the river. The remaining levee downstream to the pedestrian bridge, approximately 1300 feet downstream of 12th Street, is more substantial. The top width is 12 to 15 feet, with slopes of 1V on 3H on both sides. The remaining levee downstream of the pedestrian bridge to the downstream limit of the project is similar in section to that just described above. Also, the left bank levee is typically set back from the river approximately 100 to 200 feet. There is no riprap provided for these set back sections. The levee heights are lower, 3 to 4 feet. The 5th Street abutments are well protected by concrete lining and there are no signs of erosion.

The right bank embankment is the railroad track embankment (see Photos Two and Three). This embankment is approximately 8-12 feet above the river bank level. The embankment is approximately 40 to 50 feet in width at its crown and is sloped approximately 1V on 2H on its landside. The embankment contains two sets of railroad tracks. Each track rests atop approximately 2 feet of ballast

material. The embankment width accommodates approximately 30 feet of unimproved access road. At the landside edge of the embankment is an eight foot sound wall (see Photo Four). This sound wall is constructed in approximately 20 foot sections and is founded by a 7 foot wide, 10 foot long, 8 inch thick, foundation approximately 2.5 feet in depth below the ground surface. The foundation is tied to the wall by #3 rebar. Construction joints between the wall were observed as wide as two inches. The right embankment is well constructed and would contain flood flows adequately.

5.4.2 Soil Conditions.- A site visit was conducted of the project area in March 1992 and boring logs from the 12th Street bridge construction were reviewed by Sacramento District (see Photo Five), Geotechnical Branch, Geology Section. The foundation material for the south end of the bridge and the levee in the 12th Street location consists of a red-brown sandy silt which is stiff, grading to very stiff at some locations. The silt is underlayered with silty sand and at the time of drilling (circa 1981) was wet. It is overlain by a grey-brown sandy gravel (GP) and grey-brown sand (SP). The sandy gravel is dense and was wet to saturated at the time of drilling. The sand was loose and moist. The soil cover in the area, consists of a light brown sandy silt (ML) which is loose and dry.

5.4.3 Seismicity.- Elko is located in the eastern half of the Northern Nevada Seismic Zone (Husband, J., 1975), which is an area of approximately 73,155 square kilometers. This zone is characterized by a sparse distribution of earthquake epicenters. A compilation of data shows that in the interval from 1932 through 1972, there were a total of 19 recorded events for which magnitudes were determined on 15. Of these, 14 events were greater than magnitude 4.0 and none were greater than 6.0. In the interval from 1852 through 1931, 35 events were recorded but magnitudes were determined only on 8. Of these 8 events, all were greater than magnitude 4.0 but less than magnitude 6.0. Recurrence curves were calculated from the compiled data and the following parameters were determined for a common area of 1000 square kilometers:

Average annual number of events with magnitude greater than 4.0= .0064

Average annual number of events with magnitude greater than 6.0= .0002

Magnitude of earthquake expected once in 100 year= 3.7

Expected recurrence time of event with magnitude 7.0 shock= 17,498 years.

The closest fault thought to be capable of M7.0 event is located at the northwestern base of the Cortez Mountains approximately 35 miles southwest of Elko.

5.4.4 Borrow.- Two potential levee embankment borrow sources are located near the downstream end of the proposed project. The haul distance to the upstream end of the project would not exceed 1.5 miles. The potential riprap borrow source is located approximately 2 miles west of Elko, approximately a 3 mile haul to the project area.

5.4.5 Rehabilitation Design.- The critical 800-1000 foot section of the left bank levee, located downstream of the 12th Street bridge will rebuilt in accordance with the section shown on Figure 6. The existing freeboard is inadequate and should be adopted to be four feet (note:three feet used for freeboard per EM 1110-7-1913, four feet used 100 feet above and below bridge crossings).

5.4.6 Levee Failure Analysis.- An evaluation of the failure scenario for the existing left and right banks of the Humboldt River in the study area was conducted by Sacramento District, Geotechnical Branch, Soils Design Section and Civil Projects Branch, Civil Projects Sec A. The office report is enclosed as Attachment Three. The evaluation was based on field observations and review of original design drawings for the railroad relocation project only. The evaluation concluded that the existing left bank levee probable non-failure point is the elevation of the adjacent natural ground and the probable failure point (highly likely to fail) would be approximately 4 feet below the crown of levee for the most upstream reach of the existing levee and about 1-2 feet below the levee crown for the levee reach downstream of the initial 800-1000 feet of the existing levee. The right bank non-failure point would most likely be just at the elevation of the bottom of the ballast of the existing railroad track and the failure point not reached until flows are 2-2.5 feet encroached upon the existing soundwall.

6. Project Design.-

6.1 Levee Enlargement.- The proposed enlarged left bank levee would have a total length of 5430 feet, a standard section of 12 foot crown width with side slopes of 1V on 3H, see Figures 2 and 6. The average height of the enlarged levee would range from 9 feet downstream from the 12th Street bridge to 5th Street bridge to approximately 5 feet downstream of the 5th Street bridge. The tie-back levee, from approximately station 46+10 to station 54+30 will be an average of 2 to 3 feet in height. The levee design includes 3 feet of freeboard, 4 feet of freeboard 100 feet upstream and downstream of bridge crossings. The riprap that was previously installed is to be removed and replaced, between stations 0+00 to station 7+50 only. This includes a 21 inch riprap layer with 6 inch bedding material and filter cloth. Toe protection is provided by a built-up toe section at the base of the riprap, approximately 1.5 feet in depth and 5 feet in length. Downstream of station 7+50 the channel is very wide, overbank velocities are low, levees are setback from 100 to 200 feet from the channel bank and no bank protection is required. Maintenance inspection and access is available from public thoroughfares;therefore, no maintenance roads are included in the levee enlargement plan. The levee slope would be protected from erosion by seeding with selected mixture of native grasses. The right bank levee embankment is substantial (see Figure 4), well protected against erosion and the minimum freeboard above the 100 year flood stage was modeled to be approximately 2 feet; therefore, the right bank embankment was not enlarged or raised.

6.2 Detention Basin.- The detention basin would be located approximately 300 feet upstream of the Lemoille Highway, see Figure 3. The detention basin dam was priced as a roller-compacted concrete structure, essentially a reinforced spillway, with a vertical upstream slope, 1V on 1H downstream side slope. There would be no spillway included with the dam, flows over 100 year storage would be allowed to overtop the dam section and continue down the wash. For downstream erosion protection, a 3 foot riprap layer would be included for a distance of 100 feet downstream of the dam along the channel. Note: No allowance for sedimentation was made. Sediment would have to be removed through maintenance to retain the original level of protection. Pertinent data is as follows:

Capacity, acre-feet	15
Streambed elev. (m.s.l.)	5100

Top of Dam (m.s.l.)	5115
Length of dam, ft	180
Crown width, ft.	20
Outlet, uncontrolled, in. CMP	48

6.3 Relocations.- No electrical or gas utility relocations are anticipated. There are existing utility poles near the landside toe of the existing levee between the pedestrian bridge and 5th Street; however, all construction will take place to the waterside of the existing levee in this area. The existing 48 inch and 60 inch storm drain outlets are significantly to the waterside of the existing levee toe and should not require relocation. Two existing 36 inch conduits passing through the levee just downstream of the 12th Street bridge shall be removed and replaced at the time of the levee enlargement construction.

6.4 Recreation.- The recreation plan was provided by Environmental Resources Branch, Planning Division, Sacramento District. The plan would include a paved trail along the crown of the enlarged levee and a parking area (see Figure 7). The trail would be approximately 4,800 feet in length and 10 feet in width. The trail would be asphalt with a 4 inch stabilized aggregate base course. A gravel parking area for 5 cars would be provided near the upstream terminus of the enlarged levee near the 12th Street bridge. An access road, gravel, would be provided to the parking area from an existing secondary street (approximately 100 feet in length). Access to the trail would be provided at 12th Street (parking area), the pedestrian bridge and the downstream end of the enlarged levee.

6.5 Real Estate. The lands required for the flood protection plan consists of the following:

Levee Enlargement (enlarge/construct approximately 5300 lineal feet):

Levee easement	7.9 acres
Construction easement	0.5 acres

Detention Basin: Panorama Wash

Flood Easement	7.9 acres
Dam, fee	0.3 acres

The recreation alternative will require the purchase of the levee lands in fee over easement and 0.1 acres for parking.

7. Hazardous and Toxic Materials (HTW).- The Elko City Engineer was interviewed for knowledge of any historical land use in the project area that could lead to the potential presence of HTW. The City Engineer responded that the areas considered for improvement have not been subject to illegal dumping or previously used as commercial sites. A walk through of the areas did not reveal any surface evidence of HTW. The only suspected sites of in the city of Elko area of HTW was reported by the City Engineer to be the abandoned WPRR site (deeded to the city at the time of the "Project Lifesaver" construction) that may contain train engine oil, cleaning solvents and other contaminants. This site is somewhat downstream of the project area and not under consideration for any construction or borrow source.

8. Construction Procedure and Water Control Plan.- The project area is not subject to high flows during normal construction seasons. The Humboldt River stage is normally very low during the late spring and through the summer. No diversion of existing water or dewatering of the site is anticipated. Access to all sites is available from public thoroughfares. The construction equipment required shall be able to operate freely within the confines of the project site. Project construction should be able to be accomplished in one construction season.

9. Mitigation.- Mitigation for the levee enlargement project was coordinated by Environmental Resources Branch, Planning Division with the U.S. Fish and Wildlife Service. For the levee enlargement project construction, less than one acre of riparian vegetation would be disturbed. For cost estimating purposes, the levee improvement plan was assumed to replace the disturbed vegetation acre per acre. A development cost of approximately $ 8,000 per acre (with contingencies of 25%, for a total of $10,000 per acre) for riparian vegetation establishment was used. This cost was based on costs experienced for similar projects in the Sacramento District.

10. Cost Estimates.- The estimates of first costs (summarized below) are based on 1 October 1992 price levels. The estimated cost of lands is based on adjustments of information provided by local interests in Washoe County (coordinated by Real Estate Division). The unit prices for the construction cost estimates were based on adjustments of average bid prices received for comparable work in the subject project regional area. No detailed surveys or exploration work has been accomplished at this phase of study. All quantities are based on existing survey information and 7.5 minute USGS quadrangles. A contingency factor of 25 percent has been included in the development of the construction costs, a contingency of 35 percent was used for the estimate of lands and damages. Costs for planning, engineering, and design and costs for construction management were based on costs for similar projects in the Sacramento District. Annual costs were based on a 50 year project life (for the levee enlargement project, no replacement costs included) and 8 1/2 percent interest rate. Detailed estimates are enclosed as Attachment Four to this office report. Summary of first and annual costs follows:

LEVEE/TRAIL/CULVERT PLAN:
(rounded to nearest $10,000)- includes drainage conduits

First Costs.-

Acct. No.	Description	Total Cost $
01	Lands and Damages	660,000
06	Fish and Wildlife	10,000
11	Levees	390,000
14	Recreation Facilities	60,000
18	Cultural Resources	10,000
30	Planning, Engr and Design	60,000
31	Construction Management	40,000
	TOTAL	$ 1,230,000
	Interest during Construction	110,000
	Total Investment Cost	1,340,000

Annual Costs (rounded).

Item	Total Cost $
Interest (8 1/2 percent)	114,000
Amortization (50 year life). 000134	2,000
Operation and Maintenance	
Levee	2,300
Interior Drainage	900
Riprap	100
Recreation	700
TOTAL	$ 120,000

DETENTION BASIN (15 ACRE-FEET)
(costs for detention basin only- rounded)

First Costs.-

Acct. No.	Description	Total Cost $
01	Lands and Damages	50,000
04	Dams	230,000
06	Fish and Wildlife	30,000
30	Planning, Engr and Design	30,000
31	Construction Management	20,000
	TOTAL	**$ 360,000**
	Interest during Construction	10,000
	Total Investment Cost	370,000

Annual Costs.-

Item	Total Cost $
Interest (8 1/2 percent) and amortization	31,500
Operation and Maintenance	
Dam	1,250
Reservoir Area	750
TOTAL	**$ 33,500**

11. Scope/Costs/Schedule for Feasibility Study.-

11.1 **SOILS/GEOLOGY**.- This task includes field explorations consisting of 10 rotary drill holes through the existing left bank levees and 3-4 backhoe pits in each of three potential levee borrow sources. Drilling will be by hollow-stem auger with "continuous" Standard Penetration Testing. Laboratory testing will be conducted at the South Pacific Division lab in Sausalito, CA. Primary testing will consist of soil classification, particle-size analysis and plasticity characteristics. Soils Design Section and Geology Section shall prepare a narrative report suitable for incorporation into the Basis of Design Office Report.

11.2 **SURVEYS**.- For Feasibility level of effort, accurate ground data and survey control need to be provided. Surveys needed include cross sections at 50 ft intervals along the alignment, covering about 100 feet east of the landside toe of the levee and 100 feet or more west from the levee on the waterside of the levee. The cross sections shall commence approximately 100 feet upstream (through the 12th Street Bridge) and be complete approximately 100 feet downstream of project reach. At 500 foot intervals, the waterside cross section shall be extended across the river. The cross sections across the river shall commence from approximately 1000 feet upstream of the project reach and be completed to approximately 1000 feet downstream of the project reach. Aerial surveys could be used, tolerances not to exceed one-quarter foot plus or minus.

11.3 **HYDRAULIC DESIGN**.- The Feasibility study shall develop the pre-project and post-project backwater curves based on the surveyed cross sections and feasibility level hydrology. Risk framework studies, interior drainage, and sediment transport issues shall be addressed. Impacts due to the raising of the water surface elevation will be addressed for areas within, upstream and downstream of the project reach. Impacts of events exceeding the design event shall be evaluated. Streambank stabilization and channel stability issues shall be addressed.

11.4 **COST ESTIMATING**.- An MCACES cost estimate shall be prepared for project first and annual, and operation costs.

11.5 **BASIS OF DESIGN**.- This task includes design of the levee, drafting of the plates and figures showing the plan, profile and sections, development of quantities for cost estimating, study coordination and documentation, construction scheduling, site visit and reproduction of the narrative of the Basis of Design office report.

11.6 **REAL ESTATE**.- This task will consist of the development of Feasibility level real estate cost estimate for the temporary construction right-of-way, permanent right-of-way, and disposal site for excess foundation preparation material. Effort includes development of Gross Appraisal, detailing the value of all project costs and relocation costs under PL 91-646, the preparation of a Real Estate Map, detailing the real estate requirements including mitigation, if required. Rights-of-entry will be obtained as necessary for cultural, environmental, and engineering surveys. A Real Estate Supplement shall be prepared, which shall identify all real estate requirements for the project and contain the baseline cost estimate and acquisition schedule. The sponsor will determine their acquisition costs. All real estate work will be performed in accordance with ER 405-1-12 and EC 405-2-14. All costs, including acquisition and administrative cost will be identified in the MCACES code of accounts as required by EC 1110-2-586.

11.7 **SUMMARY OF ESTIMATED COSTS OF ABOVE STUDIES AND SCHEDULE**.-

	Total
Soils/Geology	37,000
(Explorations-Geology Sec	12,000)
(other expenses-travel,etc	3,000)
(drilling costs	10,000)
(lab costs	6,000)
(Soil Design Section	6,000)
Surveys	30,000
(Survey Section	5,000)
(Contract	25,000)
Hydraulic Design	45,000
Cost Estimating	15,000
Basis of Design	25,000
Real Estate	30,000
Total	182,000

From initiation of feasibility design studies (start of surveys) to completion of feasibility basis of design (BOD) report, a period of approximately 10 months is required.

Months

	1	2	3	4	5	6	7	8	9	10	11	12
Basis of Design	**********											
Surveys	***** (2 months)											
Geology/ Soils	******** (3 months)											
Hydraulic Design			**********		(4 months)							
Design/ Relocations					**********		(3 months)					
Real Estate					**********		(3 months)					
Cost Estimate								******(2 months)				
Narrative Report (BOD)										**** (1 month)		

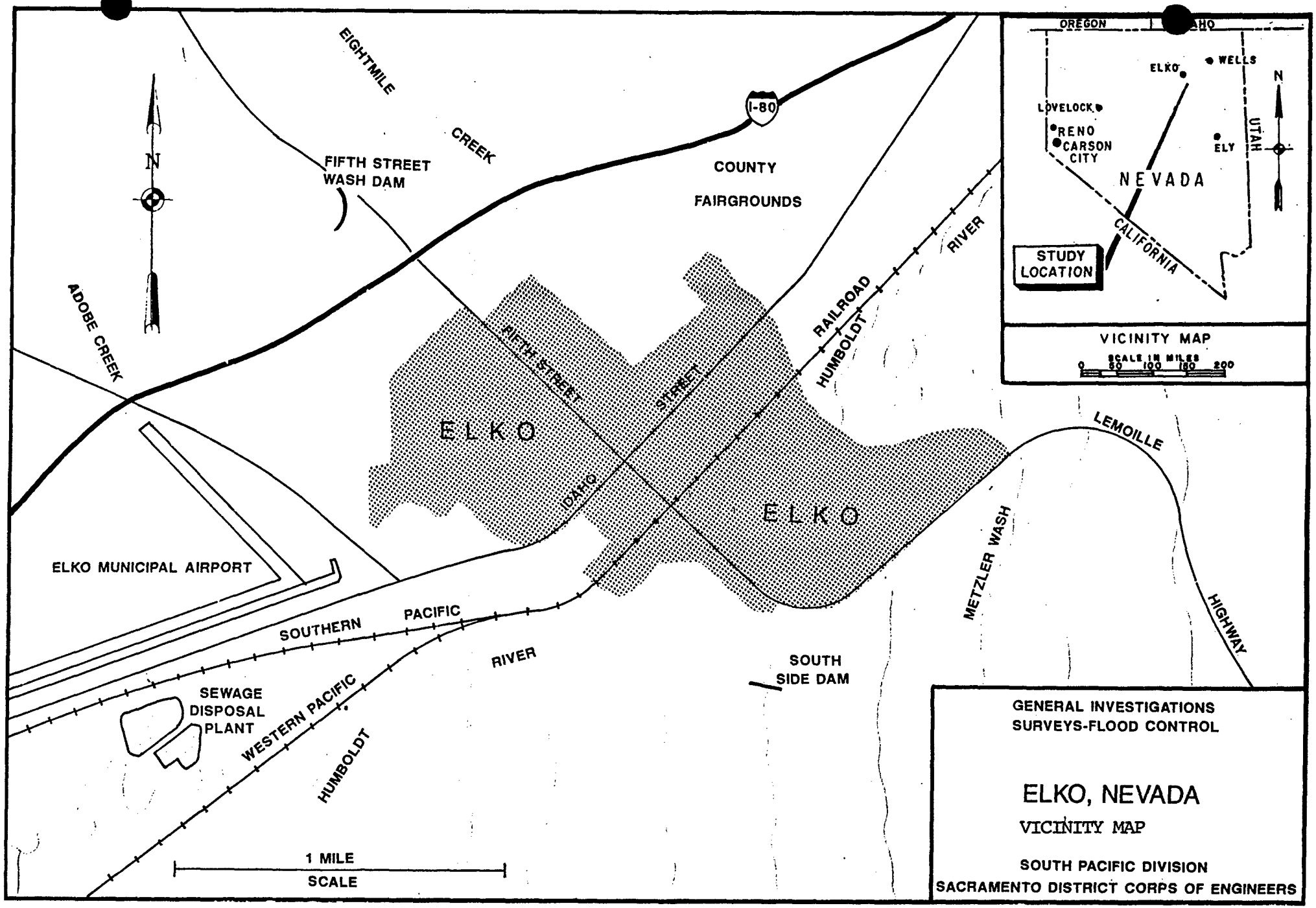
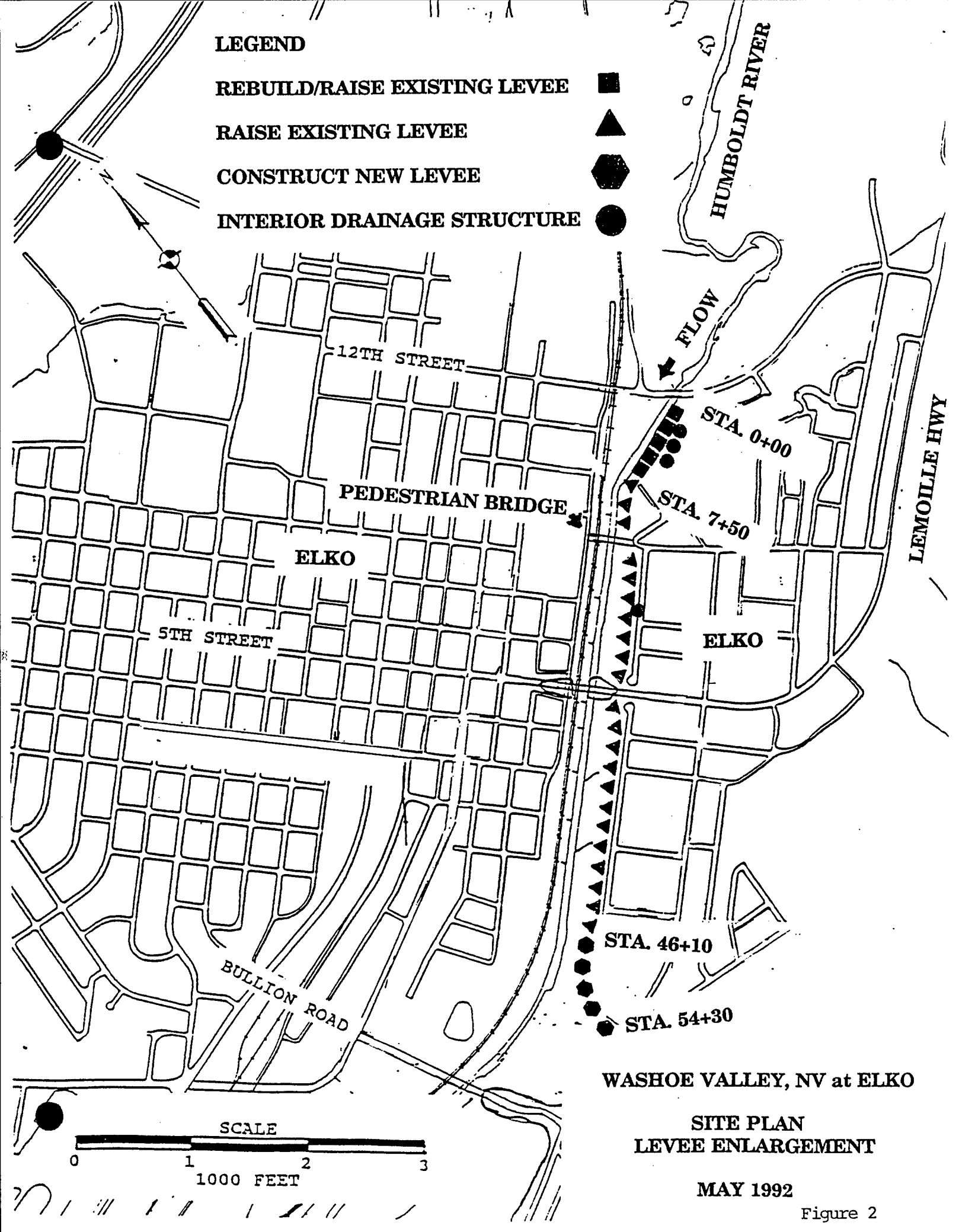

EIGHTMILE CREEK
I-80
FIFTH STREET WASH DAM
COUNTY FAIRGROUNDS
ADOBE CREEK
FIFTH STREET
9TH STREET
IDAHO
ELKO
ELKO
RAILROAD
HUMBOLDT
RIVER
ELKO MUNICIPAL AIRPORT
SOUTHERN PACIFIC
RIVER
SOUTH SIDE DAM
SEWAGE DISPOSAL PLANT
WESTERN PACIFIC
HUMBOLDT
LEMOILLE
METZLER WASH
HIGHWAY
1 MILE
SCALE
N
OREGON
ELKO
WELLS
LOVELOCK
RENO
CARSON CITY
ELY
UTAH
NEVADA
CALIFORNIA
STUDY LOCATION
VICINITY MAP
SCALE IN MILES
0 50 100 150 200
GENERAL INVESTIGATIONS
SURVEYS-FLOOD CONTROL
ELKO, NEVADA
VICINITY MAP
SOUTH PACIFIC DIVISION
SACRAMENTO DISTRICT CORPS OF ENGINEERS

Figure 1

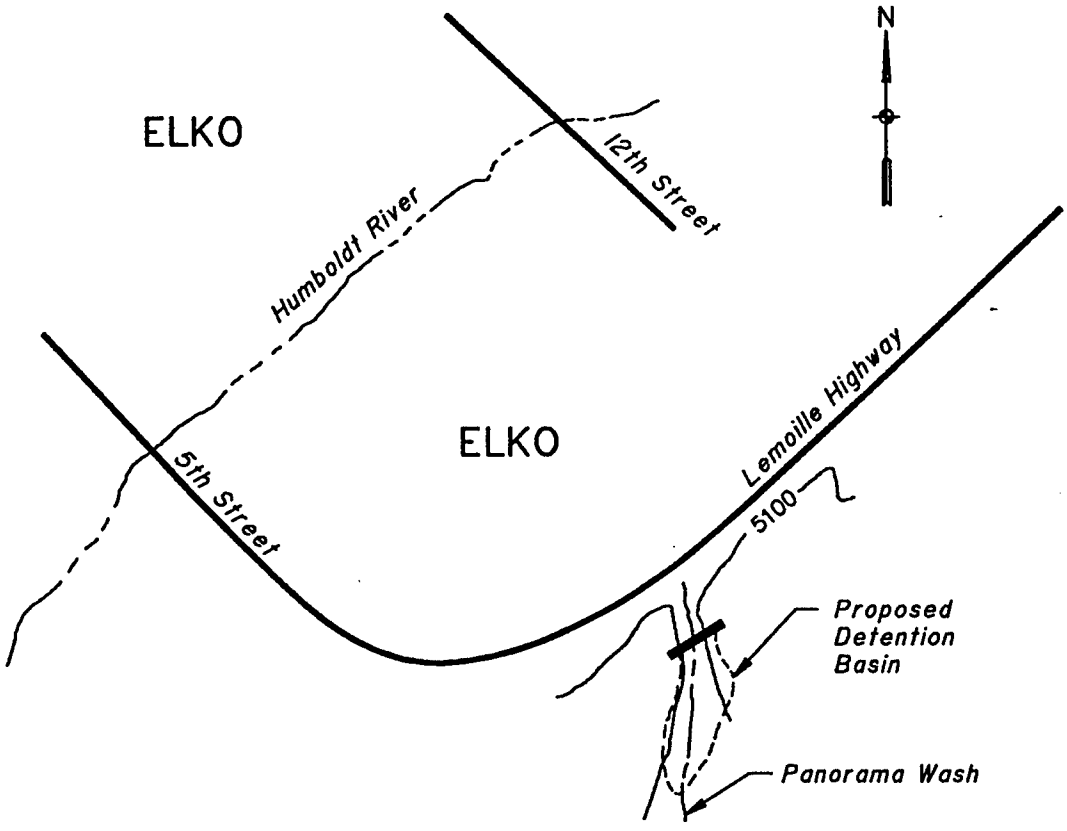


WASHOE VALLEY, NV at ELKO

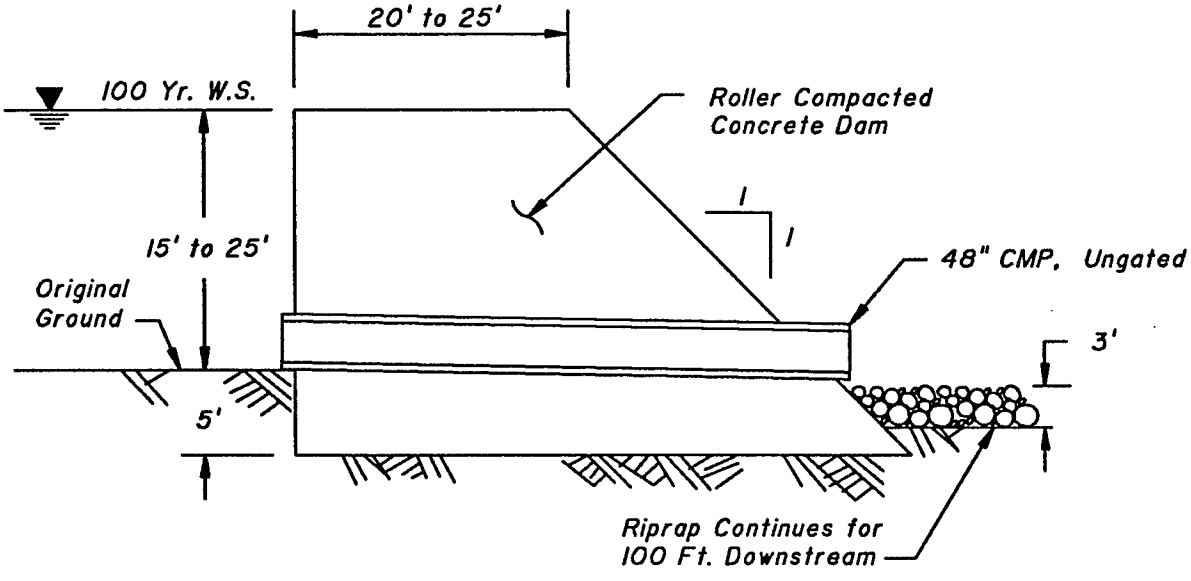
SITE PLAN
LEVEE ENLARGEMENT

MAY 1992

Figure 2



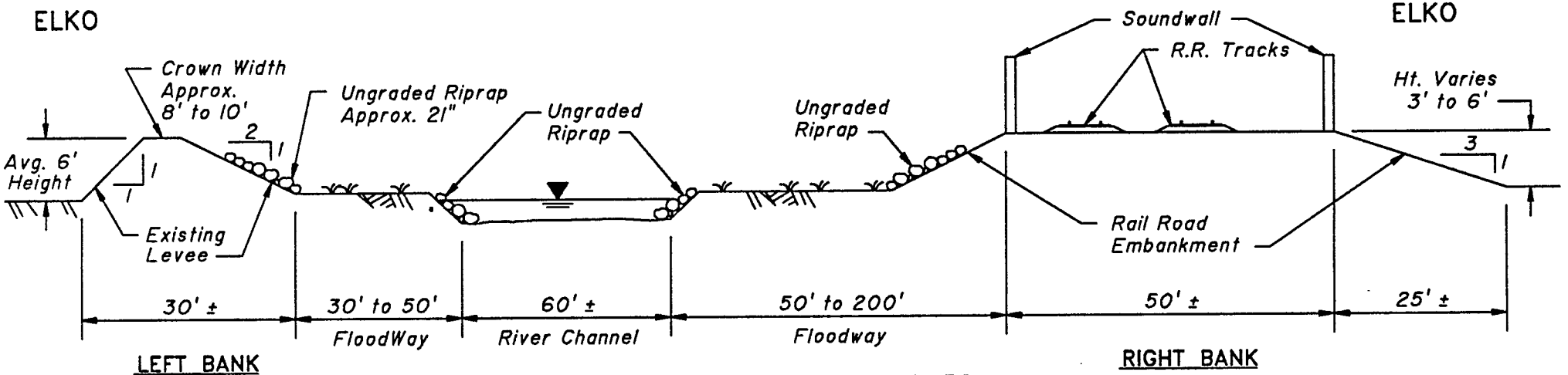
SITE PLAN
NOT TO SCALE



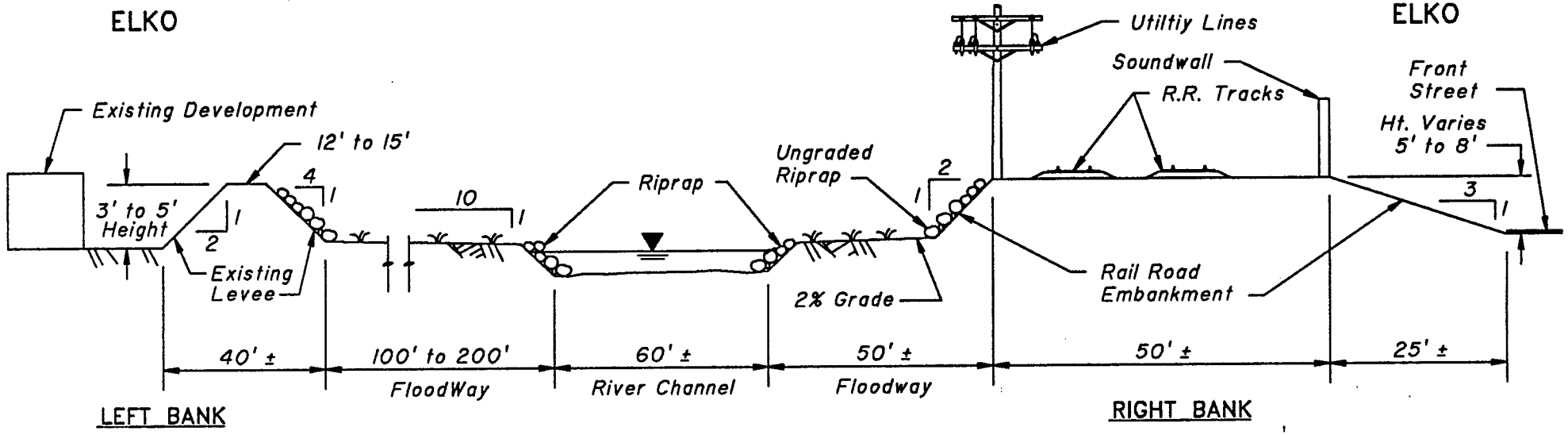
TYPICAL SECTION
NOT TO SCALE

WASHOE VALLEY, NEVADA AT ELKO
DETENTION BASIN SITE PLAN
AND TYPICAL CROSS SECTION
MAY 1992

Figure 3



STATION 0+00 to 7+50
NOT TO SCALE



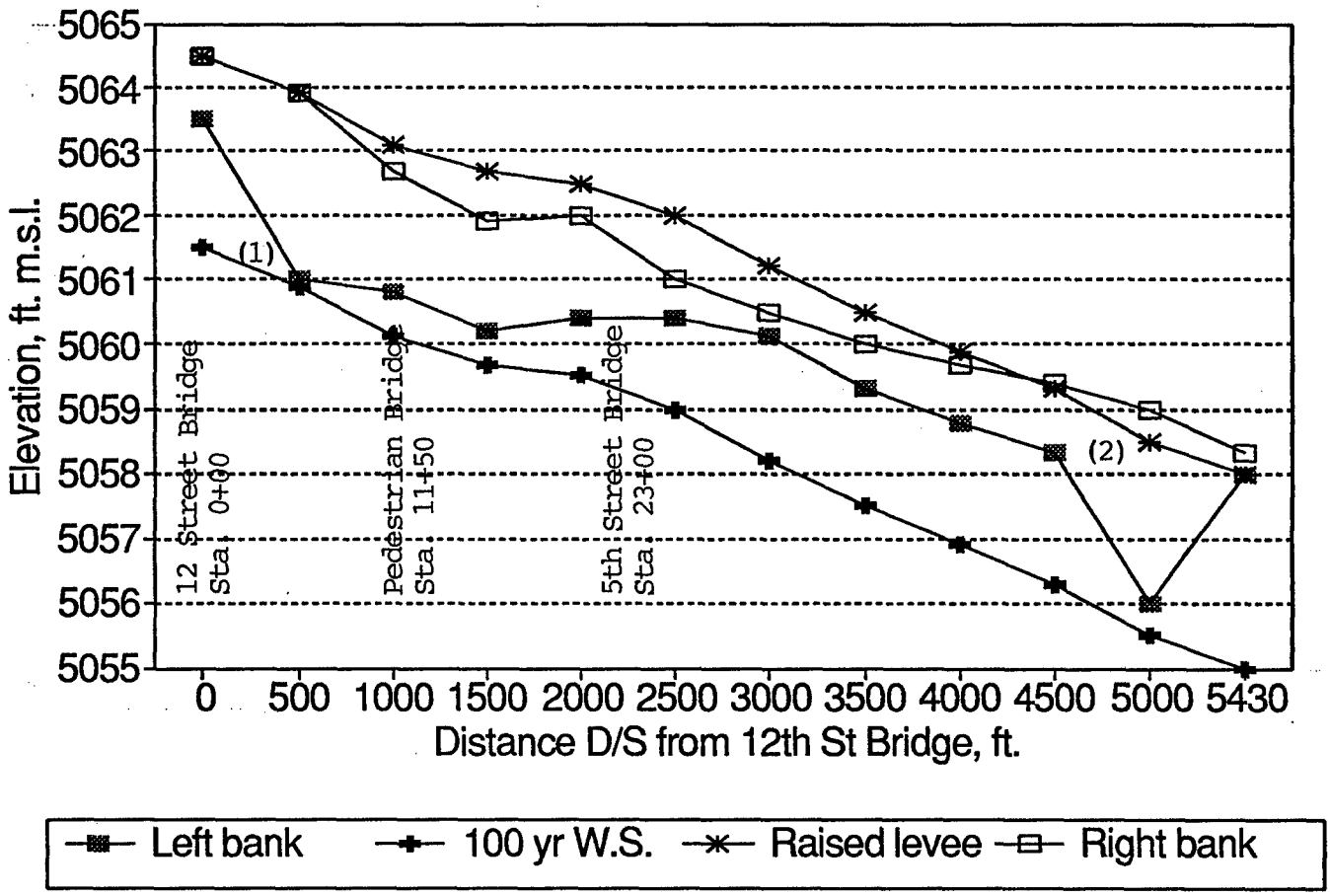
STATION 7+50 to 46+10
NOT TO SCALE

Figure 4

WASHOE VALLEY, NEVADA AT ELKO
TYPICAL SECTIONS
EXISTING
MAY 1992

Washoe Valley, Nevada at Elko

Profiles, Humboldt River



Notes: (1) Critical low point of left bank levee (station 80+00 to 150+00), approximately elevation 5060.0

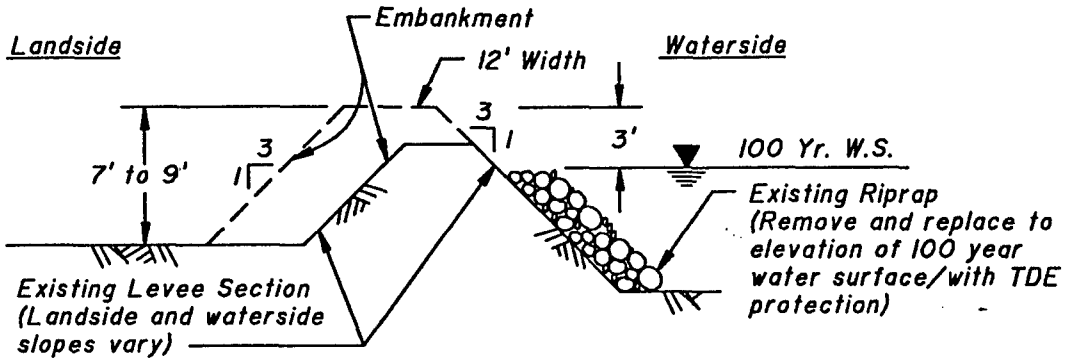
(2) End of existing left bank levee at station 46+10. From station 46+10 to 54+30 a new tie-back levee would be constructed to adjacent high ground.

Washoe Valley, NV at Elko

Profiles

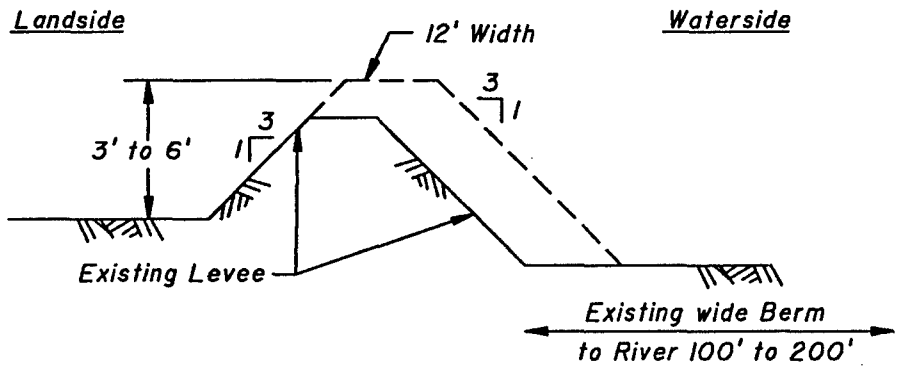
May 1992

Figure 5

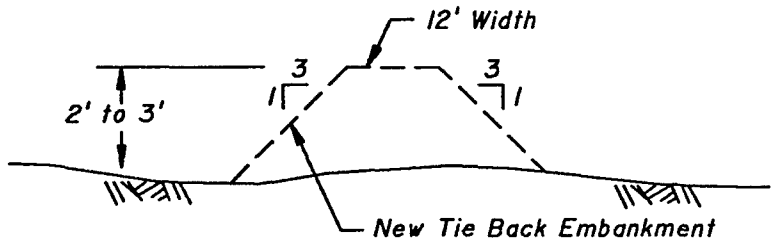


NOTE: Freeboard 4', 100' upstream and downstream of 12th Street, Pedestrian and 5th Street bridge.

STATION 0+00 TO STATION 7+50
(REBUILD EXISTING LEVEE SECTION)
NOT TO SCALE



STATION 7+50 to 46+10
NOT TO SCALE

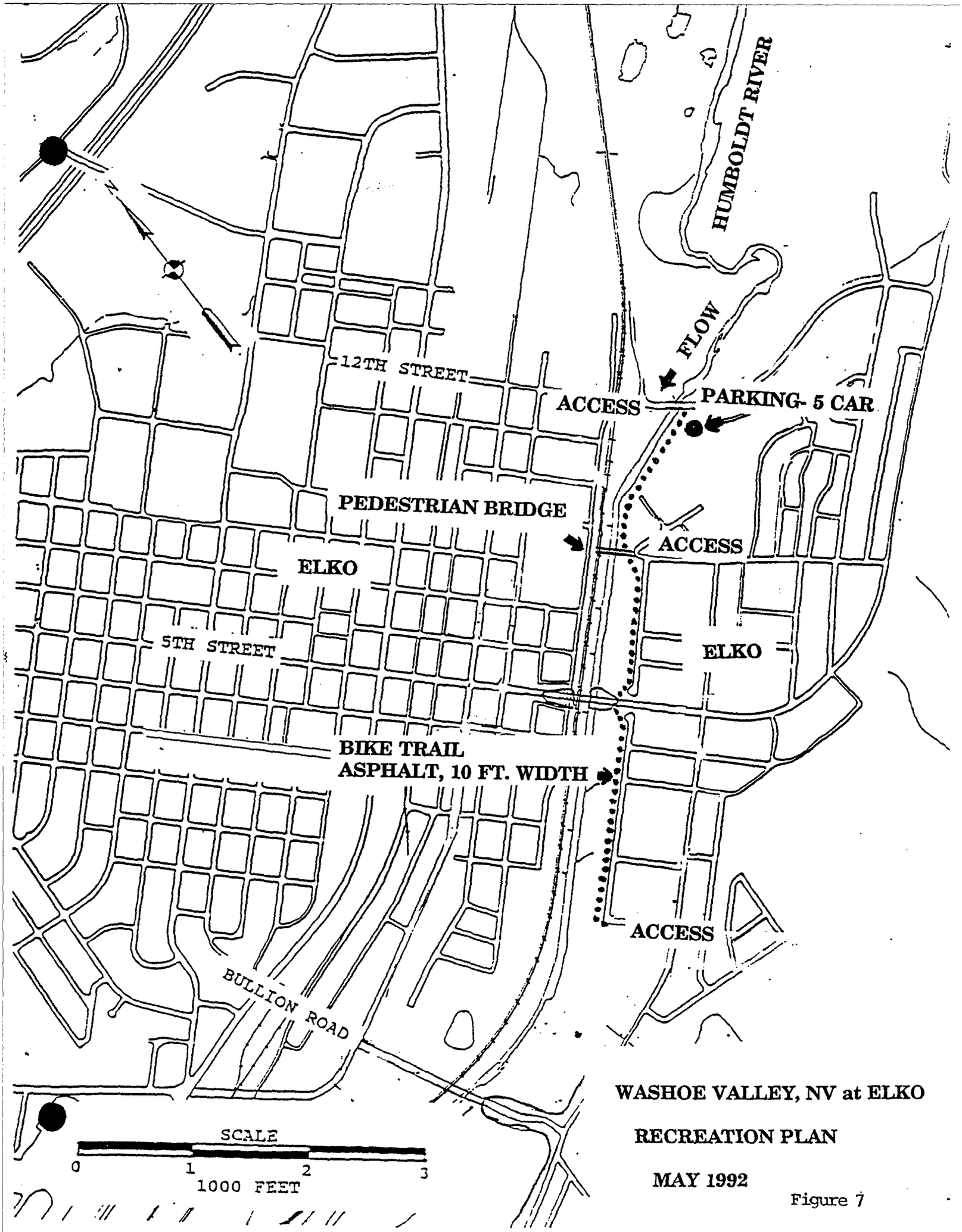


STATION 46+10 to 54+30
NOT TO SCALE

NOTE: Riprap slope protection provided on all sections 100 feet upstream and downstream of bridge crossings.

WASHOE VALLEY, NEVADA AT ELKO
TYPICAL LEVEE
ENLARGEMENT SECTION
MAY 1992

Figure 6



WASHOE VALLEY, NV at ELKO

RECREATION PLAN

MAY 1992

Figure 7

Left bank levee just downstream of 12th St. bridge

Photo One

Railroad embankment looking from left bank

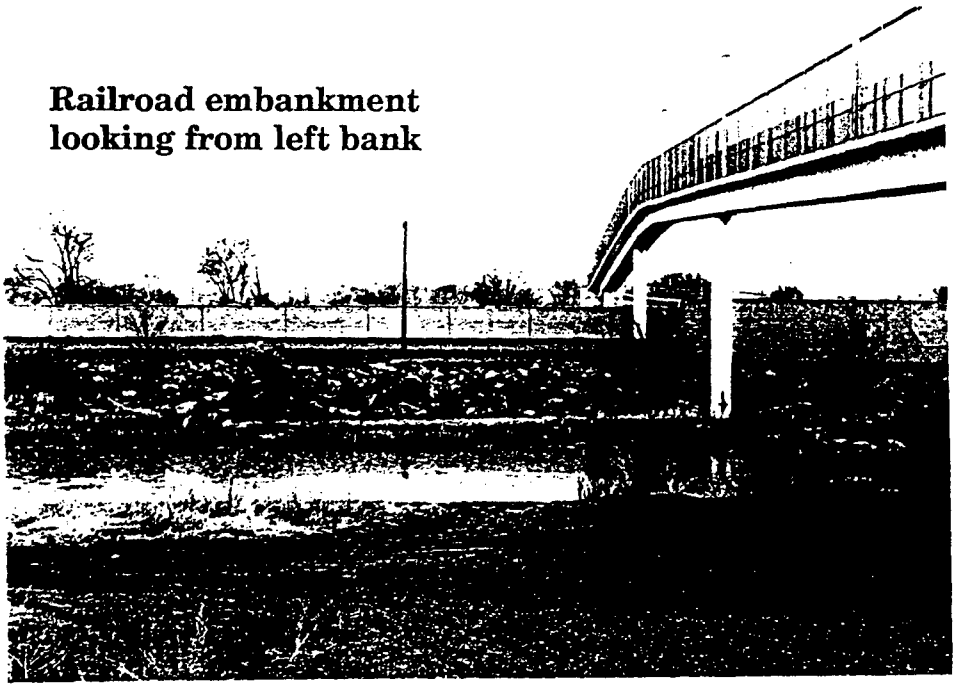


Photo Two

WASHOE VALLEY, NEVADA at ELKO

PHOTOS
1 of 3

Sound wall- landside

Photo Three

Aerial view- soundwall and railroad tracks with embankment

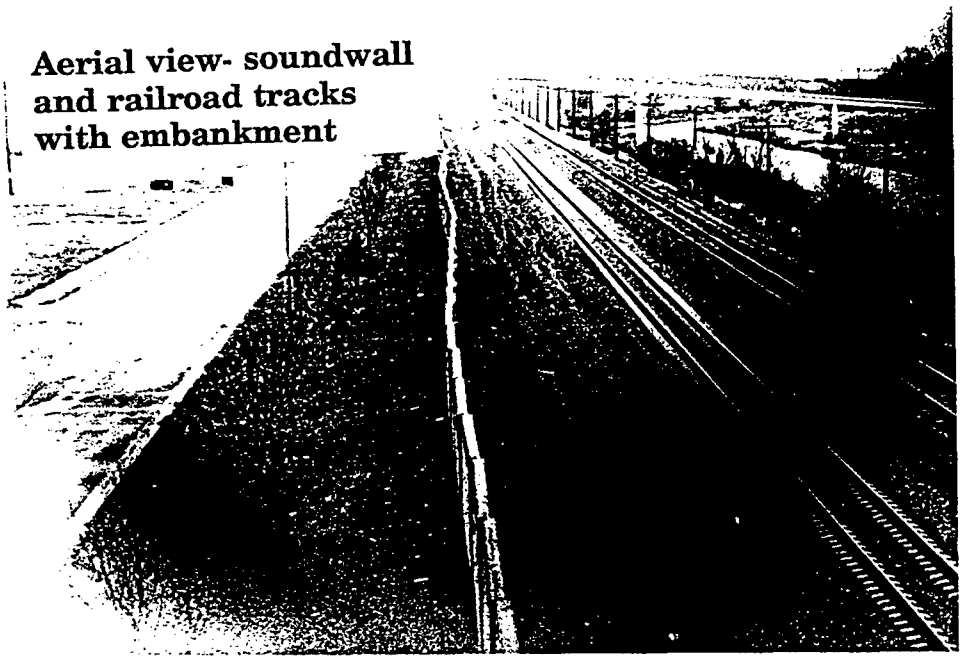


Photo Four

WASHOE VALLEY, NEVADA at ELKO

PHOTOS
2 of 3

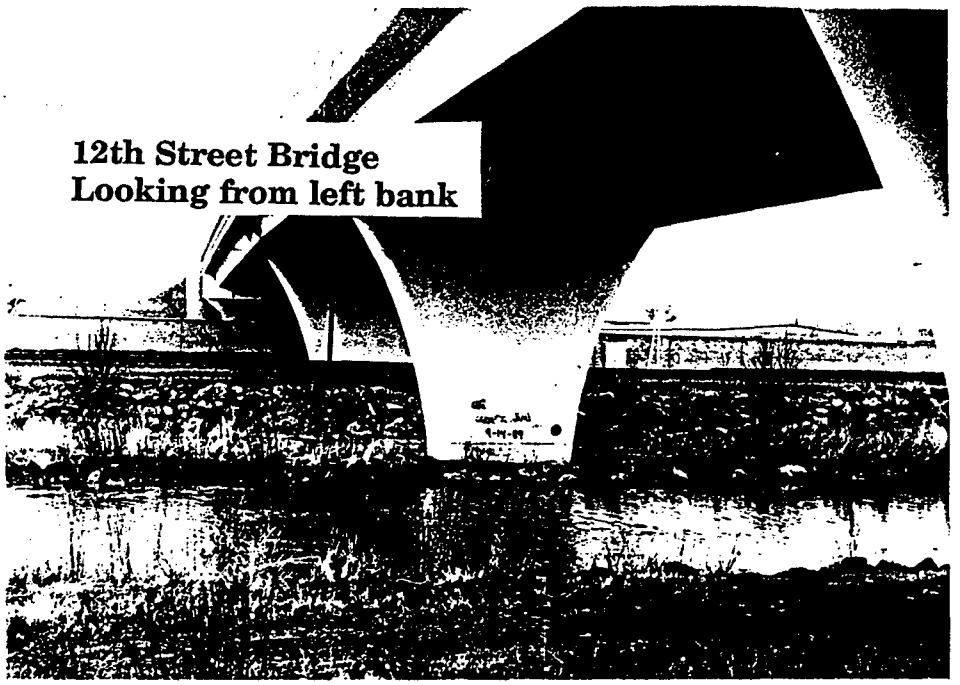


Photo Five

WASHOE VALLEY, NEVADA at ELKO

PHOTOS
3 of 3

WASHOE VALLEY, NEVADA at ELKO

OFFICE REPORT

HYDROLOGY

NOVEMBER 1991

ATTACHMENT ONE

HYDROLOGY OF THE HUMBOLDT RIVER AND THREE SMALL TRIBUTARIES NEAR ELKO, NEVADA

RECONNAISSANCE STUDY

U.S. ARMY CORPS OF ENGINEERS
SACRAMENTO DISTRICT
NOVEMBER 1991

REFERENCES

1. U.S. Army Corps of Engineers, Sacramento District, "Humboldt River and Tributaries, Nevada- Hydrology", revised June 1976.

2. Nimbus Engineers, "Hydrologic Analysis for the Humboldt River and Eleven Tributaries near Elko, Nevada", July 1991.

3. Interagency Advisory Committee on Water Data, "Guidelines for Determining Flood Flow Frequency (Bulletin #17B)", revised September 1981.

4. National Oceanic and Atmospheric Administration, "Precipitation-Frequency Atlas of the Western United States, Volume VII-Nevada", 1973.

INTRODUCTION

Purpose of Study

The purpose of this study is to:

1. Update the rainfall, snowmelt, and all-events peak flow frequency curves of the Humboldt River near Elko, Nevada (gage 10318500). The updated frequency curves can be used to evaluate potential flood control projects on the Humboldt River near Elko.

2. Develop rainfall peak flow frequency curves for three small Humboldt River tributaries- Metzler, Southside, and Panorama Wash. If the 10-year peak flows of the washes are greater than 800 cfs, then the Corps of Engineers should consider potential flood control projects on the washes.

Scope of Study

Humboldt River near Elko

The rainfall and snowmelt peak flow frequency curves of the Humboldt River near Elko were updated using 53 years of peak flows that were recorded at gage 10318500. The computer program HECWRC computed the peak flow frequency curves by distributing the peak flows according to the Log-Pearson Type III probability distribution as described in Reference 3.

The all-events peak flow frequency curve of the Humboldt River near Elko was computed by statistically combining the rainfall and snowmelt peak flow frequency curves.

The computed rainfall, snowmelt, and all-events peak flow frequency curves were compared with rainfall, snowmelt, and all-events peak flow frequency curves that were developed in two previous studies.

Humboldt River Tributaries near Elko

Rainfall peak flow frequency curves were developed for the Humboldt River tributaries of Metzler, Southside, and Panorama Wash using the computer program HEC-1. HEC-1 transformed 100-year, 24-hour rainfall into a 100-year hydrograph at the outlet of each wash. Each frequency curve passes through its computed 100-year peak flow.

The rainfall peak flow frequency curves were drawn with a slope (standard deviation) that is consistent with the slope of other Humboldt River tributary rainfall peak flow frequency curves.

The ratio of the 10-, 50-, and 500-year peak flow to the 100-year peak flow was computed for each wash from its rainfall peak

flow frequency curve. The 100-year hydrograph at the outlet of each wash was multiplied by its peak flow ratios to obtain a 10-, 50-, and 500-year hydrograph.

The 10-, 50-, 100-, and 500-year Southside Wash hydrographs were routed through a small detention dam using HEC-1. The detention dam conveys water into the Humboldt River via a 5-foot reinforced concrete pipe. A rainfall peak outflow frequency curve was developed from the routing results.

Basin Description

Humboldt River

The Humboldt River Basin occupies about 16,700 square miles of land between the Sierra Nevada and Rocky Mountains in north-central Nevada. The Humboldt River originates in the Ruby Mountains over 11,000 feet above Mean Sea Level (MSL). The river flows southwesterly through steep canyons and broad floodplains and terminates at the Humboldt Sink, about 3900 feet above MSL. Figure 1 is a topographic map of the Humboldt River Basin.

Humboldt River Tributaries near Elko

The Humboldt River tributary basins of Metzler, Southside, and Panorama Wash occupy about 1.7, 1.0, and 0.5 square miles of land south of Elko, respectively. The washes flow northward through narrow canyons with average streambed slopes of about 0.07, and discharge into the Humboldt River.

Figure 2 is a topographic map of the Metzler, Southside, and Panorama Wash Basins. The Metzler and Panorama Wash Basins were delineated only above the Lamoille Highway because the complex distribution of runoff below the highway by overland flow, diversions, and storm drains was beyond the scope of this study. An insignificant volume of local runoff enters the Humboldt River below the highway. The Southside Wash Basin was delineated only above the small detention dam for similar reasons.

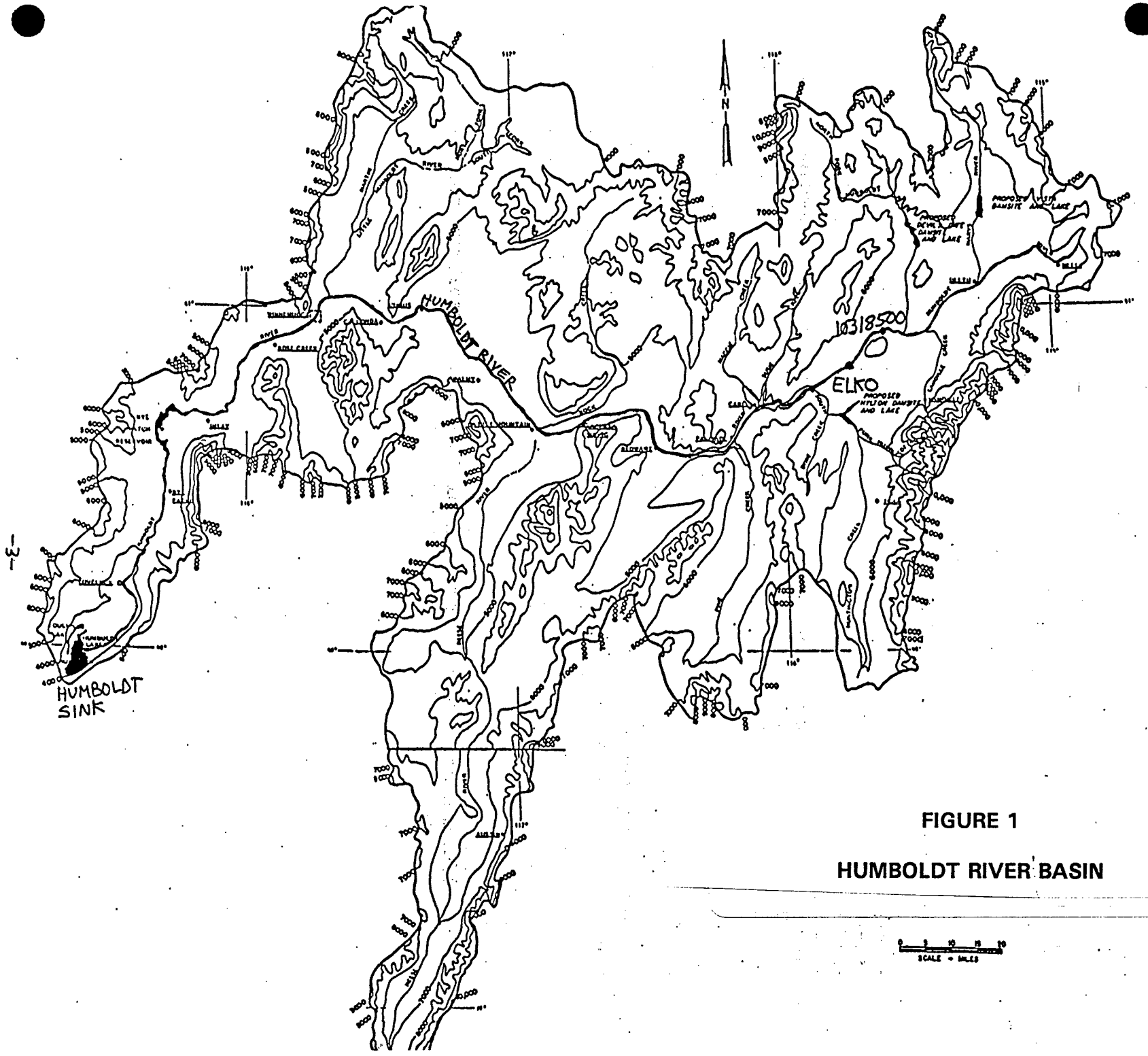


FIGURE 1

HUMBOLDT RIVER BASIN

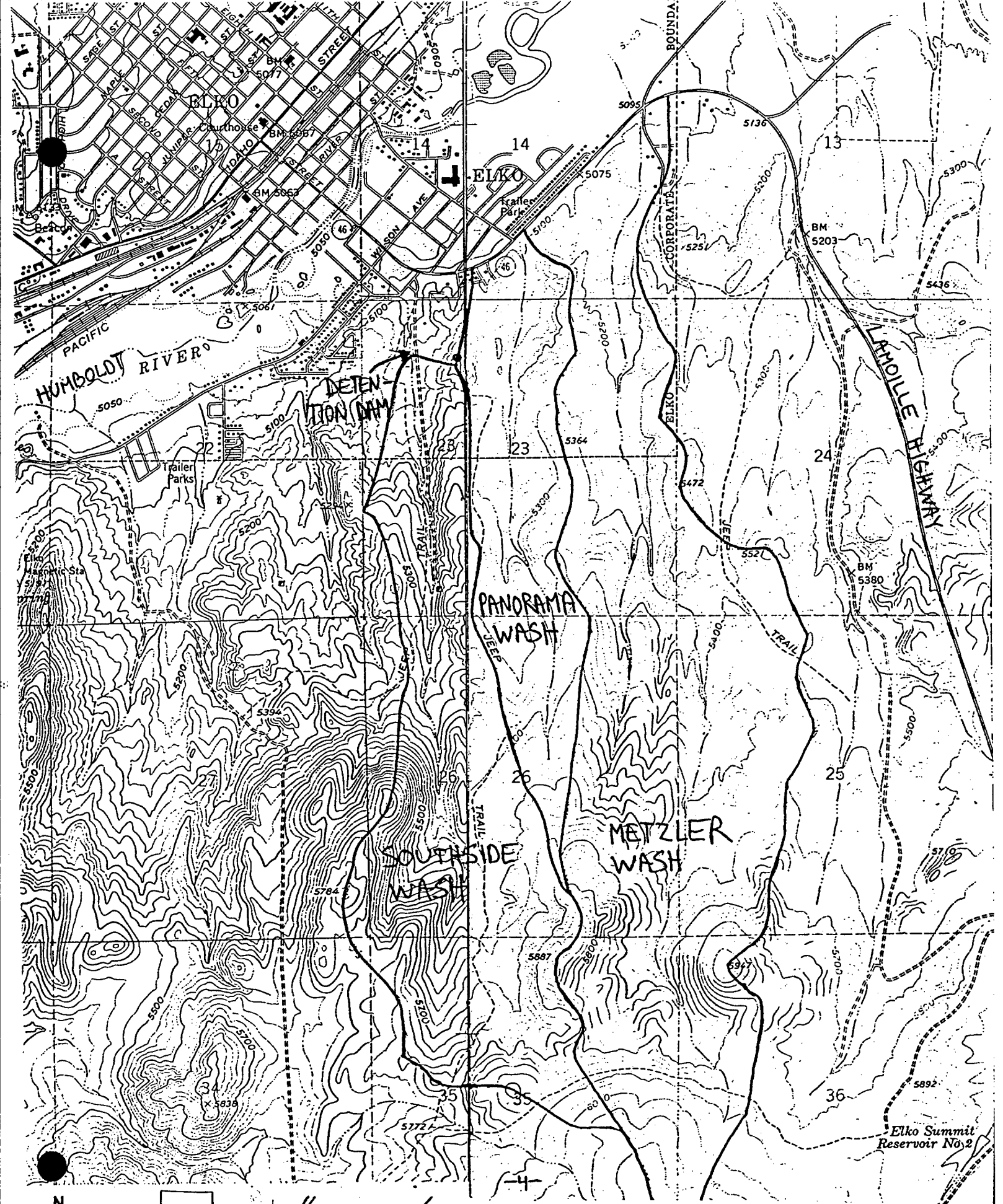


FIGURE 2

METZLER, SOUTHSIDE, AND PANORAMA WASH BASINS

FLOW FREQUENCY CURVES

Humboldt River near Elko

Rainfall Flow Frequency Curve

The rainfall peak flow frequency curve of the Humboldt River near Elko was updated using 53 years of rainfall peak flows at gage 10318500 (water years 1896-1902, 1945-1990). The gage was discontinued between water years 1903 and 1944.

Some of the rainfall peak flows were estimated from maximum 1-day rainfall flows at gage 10318500 using the computer program REGFRQ. REGFRQ developed a linear relationship between the rainfall peak and maximum 1-day flows by the "method of least squares".

Computer program HECWRC read the observed and estimated rainfall peak flows and computed the rainfall peak flow frequency curve. The flow frequency curve has the following Log-Pearson Type III statistics:

mean	= 2.7367
standard deviation	= 0.4962
computed skew	= 0.1221
regional skew	= 1.0000
adopted skew	= 0.3000

The regional skew was obtained from Reference 1 and was weighted with the computed skew according to the guidelines in Reference 3. The weighted skew was adopted.

Figure 3 shows the computed rainfall peak flow frequency curve of the Humboldt River near Elko. The observed and estimated rainfall peak flows from which the frequency curve was derived are shown at Median plotting positions. The rainfall peak flow frequency curve from a 1976 Corps of Engineers study is shown for comparison.

Snowmelt Flow Frequency Curve

The snowmelt peak flow frequency curve of the Humboldt River near Elko was updated using 53 years of snowmelt peak flows at gage 10318500 (water years 1896-1902, 1945-1990). Peak flows after March 15 were considered snowmelt peak flows.

Some of the snowmelt peak flows were estimated from maximum 1-day snowmelt flows at gage 10318500 using REGFRQ. REGFRQ developed a linear relationship between the snowmelt peak and maximum 1-day flows.

HECWRC read the observed and estimated snowmelt peak flows and computed the snowmelt peak flow frequency curve. HECWRC identified a low outlier in 1959 and made the conditional probability adjustment. The flow frequency curve has the following Log-Pearson Type III statistics:

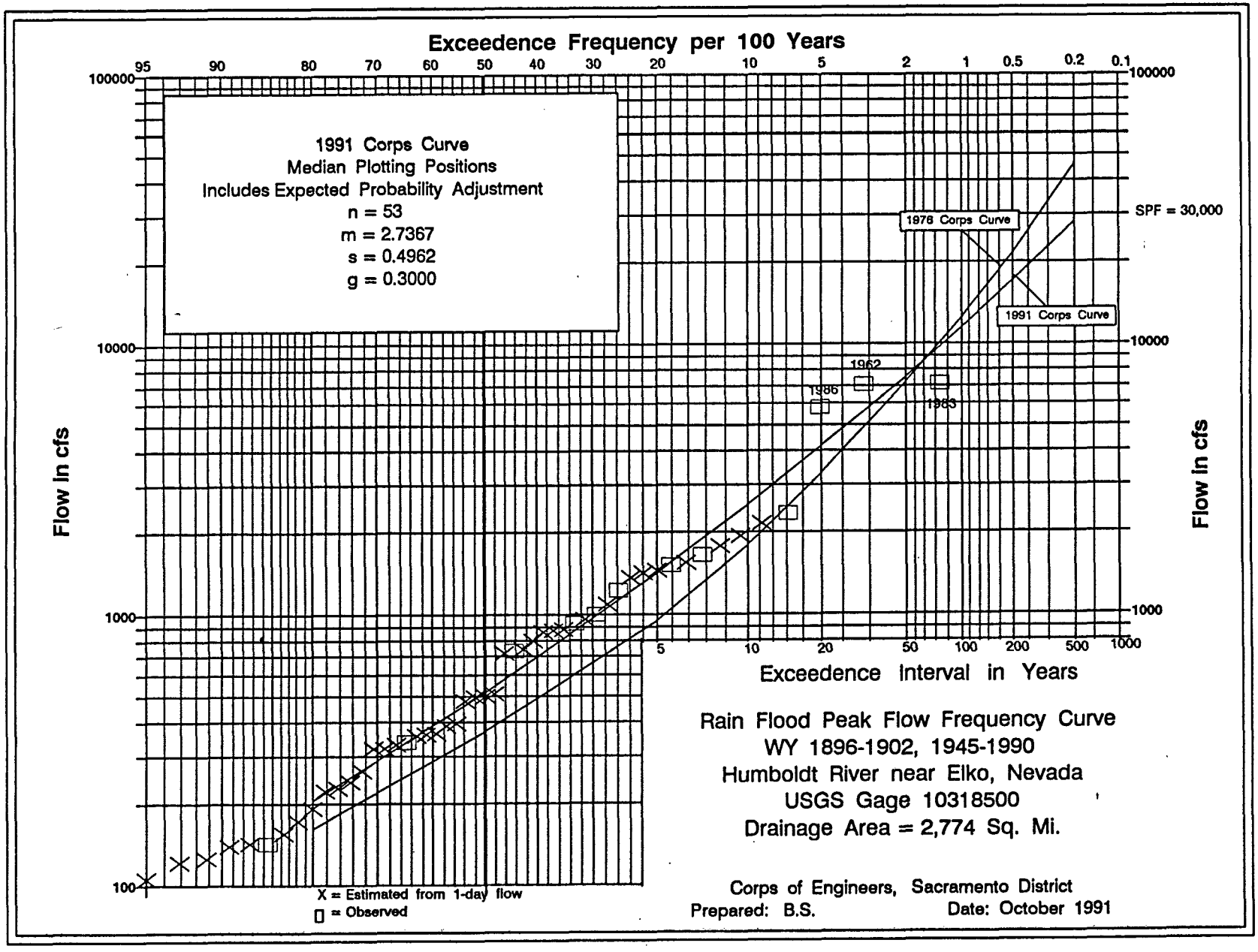

Exceedence Frequency per 100 Years
95 90 80 70 60 50 40 30 20 10 5 2 1 0.5 0.2 0.1
100000
10000
1000
100
1991 Corps Curve
Median Plotting Positions
Includes Expected Probability Adjustment
n = 53
m = 2.7367
s = 0.4962
g = 0.3000
1976 Corps Curve
1991 Corps Curve
SPF = 30,000
1962
1986
1983
Flow in cfs
Flow in cfs
5 10 20 50 100 200 500 1000
Exceedence Interval in Years
Rain Flood Peak Flow Frequency Curve
WY 1896-1902, 1945-1990
Humboldt River near Elko, Nevada
USGS Gage 10318500
Drainage Area = 2,774 Sq. Mi.
X = Estimated from 1-day flow
□ = Observed
Corps of Engineers, Sacramento District
Prepared: B.S. Date: October 1991

FIGURE 3

mean =	3.0851
standard deviation =	0.3246
computed skew =	-0.3906
regional skew =	0.0000
adopted skew =	-0.3000

The regional skew was obtained from Reference 1 and was weighted with the computed skew. The weighted skew was adopted.

Figure 4 shows the computed snowmelt peak flow frequency curve of the Humboldt River near Elko. The observed and estimated snowmelt peak flows from which the frequency curve was derived are shown at Median plotting positions. Note that the peak flow of the 1984 snowmelt flood is the same magnitude as the peak flow of the snowmelt Standard Project Flood (SPF). The 1976 Corps snowmelt peak flow frequency curve is shown for comparison.

All-events Flow Frequency Curve

The all-events peak flow frequency curve of the Humboldt River near Elko was computed by statistically combining the rainfall and snowmelt peak flow frequency curves. The statistical equation for the union of two non-exclusive samples was applied:

$$P(A) = P(R) + P(S) - P(R) \times P(S)$$

where

P(A) = probability of exceeding a given all-events flow

P(R) = probability that a rainfall flow exceeds the all-events flow

P(S) = probability that a snowmelt flow exceeds the all-events flow

Figure 5 shows the computed all-events peak flow frequency curve of the Humboldt River near Elko. The 1976 Corps all-events peak flow frequency curve is shown for comparison.

Comparison of Flow Frequency Curves

The computed rainfall, snowmelt, and all-events peak flow frequency curves of the Humboldt River near Elko were compared with rainfall, snowmelt, and all-events peak flow frequency curves in two previous studies- the 1976 Corps of Engineers study, and a 1991 Nimbus Engineers study. Table 1 lists the 10-, 50-, 100-, and 500-year peak flows for every type of flood and for every study.

Table 1 shows that the 10- and 50-year peak flows in this study, which included the expected probability adjustment, are the greatest. The 100- and 500-year snowmelt peak flows also are the greatest. However, the 100- and 500-year rainfall and all-events peak flows are smaller than those flows in the 1976 Corps study which adopted a large skew of 1.0.

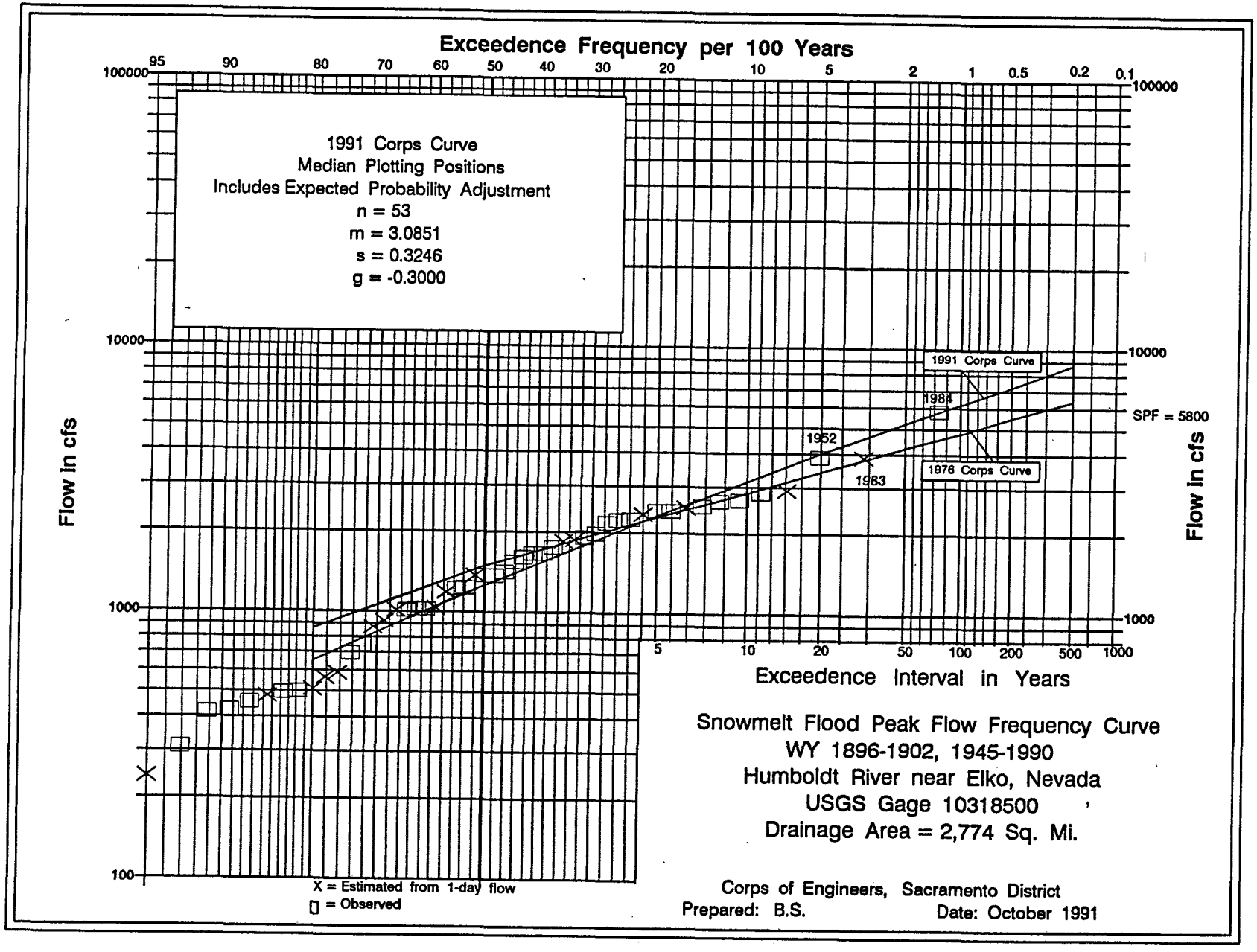

Exceedence Frequency per 100 Years
95 90 80 70 60 50 40 30 20 10 5 2 1 0.5 0.2 0.1
100000
10000
1000
100
1991 Corps Curve
Median Plotting Positions
Includes Expected Probability Adjustment
n = 53
m = 3.0851
s = 0.3246
g = -0.3000
1991 Corps Curve
1984
1952
1983
1976 Corps Curve
SPF = 5800
Flow in cfs
Flow in cfs
5 10 20 50 100 200 500 1000
Exceedence Interval in Years
Snowmelt Flood Peak Flow Frequency Curve
WY 1896-1902, 1945-1990
Humboldt River near Elko, Nevada
USGS Gage 10318500
Drainage Area = 2,774 Sq. Mi.
X = Estimated from 1-day flow
□ = Observed
Corps of Engineers, Sacramento District
Prepared: B.S. Date: October 1991

FIGURE 4

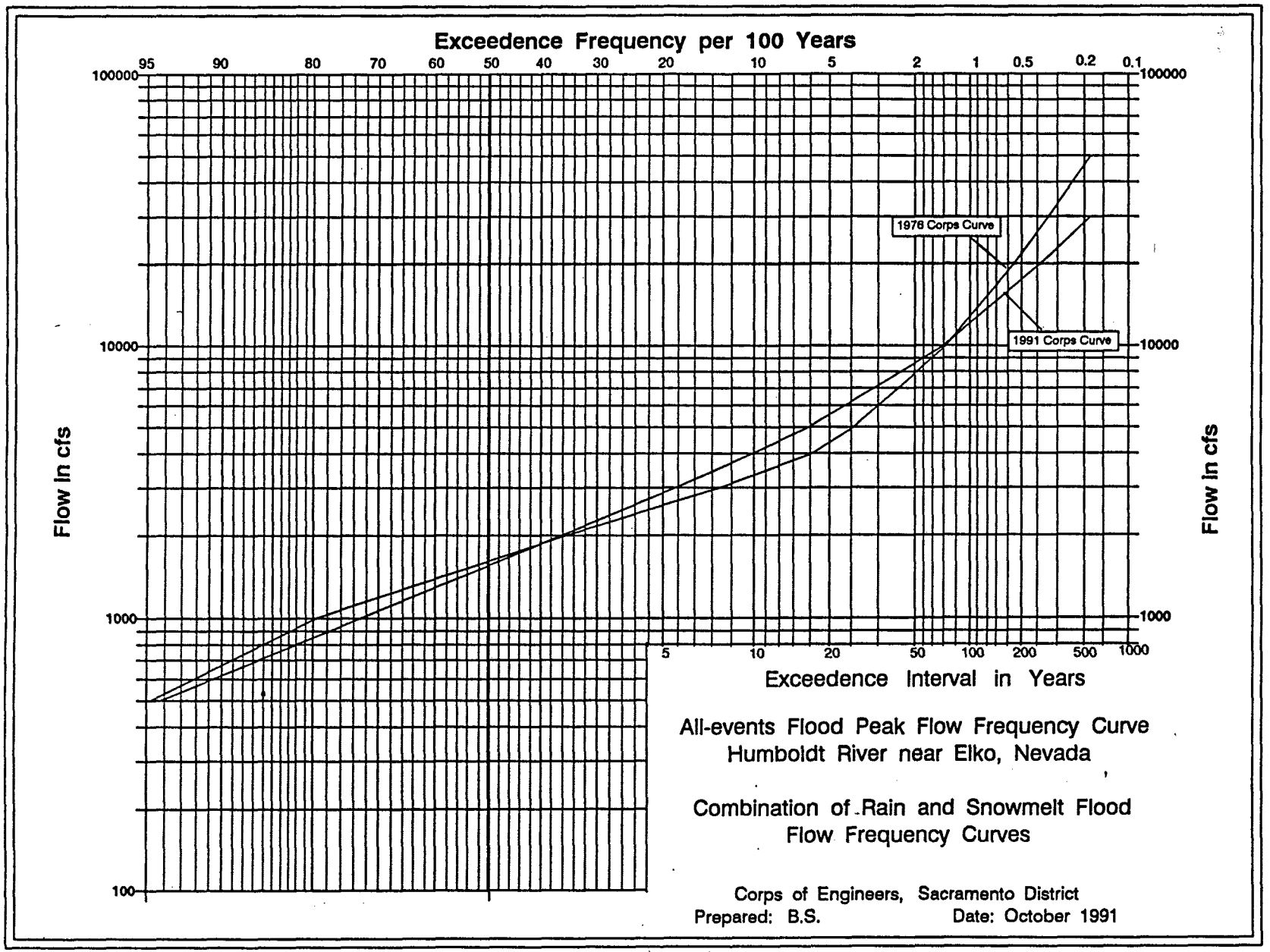

Exceedence Frequency per 100 Years
95 90 80 70 60 50 40 30 20 10 5 2 1 0.5 0.2 0.1
100000
10000
1000
100
Flow in cfs
1976 Corps Curve
1991 Corps Curve
5 10 20 50 100 200 500 1000
Exceedence Interval in Years
All-events Flood Peak Flow Frequency Curve
Humboldt River near Elko, Nevada
Combination of Rain and Snowmelt Flood
Flow Frequency Curves
Corps of Engineers, Sacramento District
Prepared: B.S. Date: October 1991

FIGURE 5

TABLE 1

Peak Flows in cfs
Humboldt River near Elko

	500-year	100-year	50-year	10-year
1991 Nimbus				
Rainfall	22800	10170	6920	2440
Snowmelt	6060	5050	4530	3110
All-events	26000	10200	7200	3800
1976 Corps				
Rainfall	46000	12500	7200	1800
Snowmelt	6400	4800	4200	2850
All-events	47000	12800	7820	3350
1991 Corps				
Rainfall	28300	11500	7540	2530
Snowmelt	8710	6190	5210	3140
All-events	28400	12100	8580	4000

Note: The 1991 Corps peak flows include the expected probability adjustment.

Humboldt River Tributaries near Elko

HEC-1 Model

Rainfall

Rainfall peak flow frequency curves for Metzler, Southside, and Panorama Wash were developed from an HEC-1 model of the washes. The HEC-1 model, shown in Table 2, contains a rainfall depth and distribution, infiltration loss rates, and unit hydrographs.

A 100-year, 24-hour rainfall of 2.15 inches was computed from Reference 4, of which 1.16 inches falls during the maximum hour. A triangular hyetagraph distributed the 2.15 inches of rain over each wash.

Infiltration Loss Rates

An initial infiltration loss of 0.5 inches and a constant infiltration loss rate of 0.02 inches/hour were used for each wash. These loss rates were calibrated from the severe 1962 rainstorm in the Humboldt River Basin, as explained in Reference 1.

Unit Hydrographs

Excess rainfall was converted to runoff using a 5-minute unit hydrograph for each wash. The unit hydrographs were computed using the computer program UHG. UHG computes a unit hydrograph based on the physical characteristics and the drainage characteristics of a drainage basin.

UHG required four parameters to describe the physical characteristics of each wash- L, Lca, DA, and DEL. Table 3 lists and defines these parameters. L, Lca, and DA were estimated from measurements that were taken from 7.5-minute United States Geological Survey (USGS) quadrangles. DEL was estimated from contour lines on the quadrangles.

UHG required an S-graph to describe the drainage characteristics of each wash. A previously derived S-graph was used. The S-graph, constructed from the Elko Local unit hydrograph that is contained in Reference 1, is representative of the time distribution of runoff in each wash.

Comparison of 100-year Peak Flows

The HEC-1 model computed 100-year hydrographs at the outlet of Metzler, Southside, and Panorama Wash. The 100-year peak flows were compared with the 100-year peak flows in three previous studies- the 1991 Nimbus Engineers study, a 1983 USGS flood insurance study, and a 1978 Soil Conservation Service (SCS) study.

Table 4 lists the 100-year peak flows for each wash and for each study. Table 4 shows that the 100-year Metzler and Southside Wash peak flows in this study are similar to the 100-year Metzler and Southside Wash peak flows in the 1991 Nimbus study. The 100-

TABLE 2
HEC-1 Model of Washes

```
ID  FILENAME ELKO100
ID  100-YR 24-HR RAIN STORM IN ELKO, NV
ID  USING NOAA RAINFALL AND A TRIANGULAR DISTRIBUTION
ID  OCT 1991
*FREE
*DIAGRAM
IT 5 01JAN99 0100 300
IO 2
PG 1 2.15
PG 2
PI 19 19 19 19 19 19 19 19 19 19
PI 19 19 19 19 19 19 19 19 19 19
PI 19 19 19 19 19 19 19 19 19 19
PI 19 19 19 19 19 19 19 19 19 19
PI 19 19 19 19 19 19 19 19 19 19
PI 19 19 19 19 19 19 19 19 19 19
PI 19 19 19 19 19 19 19 19 19 19
PI 19 19 33 33 33 33 33 33 33 33
PI 33 33 33 33 33 33 33 33 33 33
PI 33 33 33 33 33 33 33 33 33 33
PI 33 33 33 33 33 33 33 33 75 75
PI 75 75 75 75 75 75 75 75 75 75
PI 75 75 75 75 75 75 83 83 83 83
PI 83 83 92 92 92 92 92 92 400 400
PI 400 870 870 1800 3400 1400 870 400 400 400
PI 92 92 92 92 92 92 83 83 83 83
PI 83 83 75 75 75 75 75 75 75 75
PI 75 75 75 75 75 75 75 75 75 75
PI 33 33 33 33 33 33 33 33 33 33
PI 33 33 33 33 33 33 33 33 33 33
PI 33 33 33 33 33 33 33 33 33 33
PI 33 33 33 33 33 33 19 19 19 19
PI 19 19 19 19 19 19 19 19 19 19
PI 19 19 19 19 19 19 19 19 19 19
PI 19 19 19 19 19 19 19 19 19 19
PI 19 19 19 19 19 19 19 19 19 19
PI 19 19 19 19 19 19 19 19 19 19
PI 19 19 19 19 19 19 19 19 19 19
PI 19 19 19 19 19 19 19 19
KK SSA SOUTHSIDE WASH ABOVE DAM
BA 0.99
PT 1
PR 2
LU .5 .02
UI 20 60 100 144 204 253 298 344 405 431
UI 449 457 465 457 420 376 346 313 277 235
UI 200 176 160 137 117 104 94 80 69 62
UI 55 47 41 37 32 27 24 22 19 16
UI 14 13 11 9 9 8 6 6 5 5
UI 4 3 1
ZW A=ELKO B=SOUTHSIDE C=FLOW-RES IN F=100-YR
KK PW PANORAMA WASH AT LAMOILLE HWY
BA 0.52
PT 1
PR 2
LU .5 .02
UI 18 53 90 141 183 223 274 304 304 316
UI 309 272 242 213 179 144 121 106 86 72
```

TABLE 2, continued
HEC-1 Model of Washes

```
UI 63 51 43 37 30 26 22 18 16 13
UI 11 9 8 6 6 5 4 3 3 2
UI 1
ZW A=ELKO B=PANORAMA C=FLOW F=100-YR
KK MW METZLER WASH AT LAMOILLE HWY
BA 1.73
PT 1
PR 2
LU .5 .02
UI 22 65 109 152 202 271 325 376 424 506
UI 576 596 620 618 614 604 593 582 571 554
UI 522 456 419 379 332 291 259 237 221 195
UI 171 154 142 131 115 101 91 85 77 67
UI 60 54 51 45 40 35 32 30 27 23
UI 21 19 18 16 14 12 12 11 9 8
UI 7 7 7 6 5 4 2
ZW A=ELKO B=METZLER C=FLOW F=100-YR
ZZ
```

TABLE 3
Basin Parameters

Basin	L	Lca	DA	DEL
Metzler Wash	3.7	2.0	1.7	1315
Southside Wash	2.7	1.5	1.0	1020
Panorama Wash	2.1	0.9	0.5	730

L = length of main stream from outlet to divide (miles)
Lca = distance from outlet to a point on the main stream nearest the centroid of the basin (miles)
DA = drainage area (square miles)
DEL = maximum elevation change (feet)

year Panorama Wash peak flow in this study is similar to the 100-year Panorama Wash peak flow in the 1983 USGS study.

Figure 6 shows csm, the ratio of the peak flow in a stream to the drainage area of the stream, versus drainage area for 100-year rain floods in various Nevada streams. Metzler, Southside, and Panorama Wash plot well in the scatter of points.

Slope of Flow Frequency Curves

The rainfall peak flow frequency curves for Metzler, Southside, and Panorama Wash were constructed by drawing lines through each of the 100-year peak flows. The slope (standard deviation) of the lines was derived from Figure 7.

Figure 7 shows the slope of six Humboldt River tributary rainfall peak flow frequency curves. The frequency curve of the smallest of these tributaries has the steepest slope (greatest standard deviation). That slope, 0.7, was adopted for the frequency curves of the tiny Humboldt River tributaries of Metzler, Southside, and Panorama Wash.

Development of 10-, 50-, and 500-year Hydrographs

The ratio of the 10-, 50-, and 500-year peak flow to the 100-year peak flow was computed for each wash from its rainfall peak flow frequency curve. The 100-year hydrograph at the outlet of each wash was multiplied by its peak flow ratios to obtain a 10-, 50-, and 500-year hydrograph.

Southside Wash Detention Dam Outflow Frequency Curve

The 10-, 50-, 100-, and 500-year Southside Wash hydrographs were routed through the Southside Wash Detention Dam to develop a rainfall peak outflow frequency curve. The Modified Puls routing option in HEC-1 was used.

An initial pool elevation of 5125 feet above MSL (dam mostly empty) was assumed. The storage-elevation-discharge relationship in Reference 2 was used.

The peak flows of the routed 10-, 50-, 100-, and 500-year hydrographs were plotted on log-probability paper. The 500-year peak outflow equals the 500-year peak inflow because the 500-year hydrograph fails the detention dam.

The rainfall peak outflow frequency curve was constructed by drawing a curved line connecting the four peak outflows. However, the frequency curve was straightened to be consistent with the straight frequency curves of Metzler, Southside, and Panorama Wash.

Results

All of the computed hydrographs and frequency curves are shown in Figures 8 through 12. Figures 8, 9, and 10 contain the computed 10-, 50-, 100-, and 500-year hydrographs of Metzler, Southside, and Panorama Wash, respectively. Figure 11 contains the computed

TABLE 4
100-year Peak Flows in cfs

	Metzler Wash	Southside Wash	Panorama Wash
1991 Nimbus	730	500	230
1983 USGS	930	660	330
1978 SCS	780	665	360
1991 Corps	700	500	320

FIGURE 6
CSM VS DRAINAGE AREA
100-YEAR RAIN FLOODS

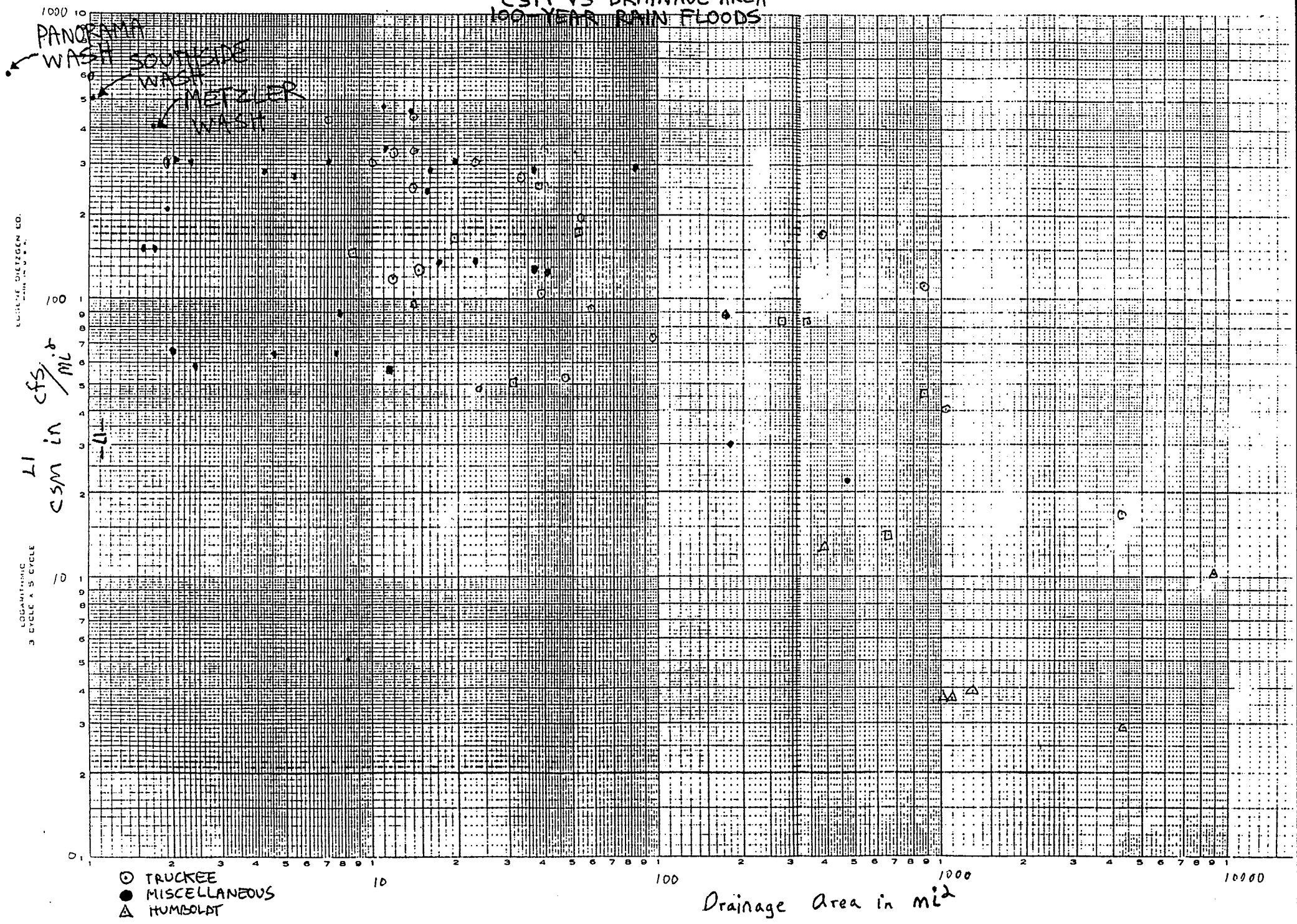
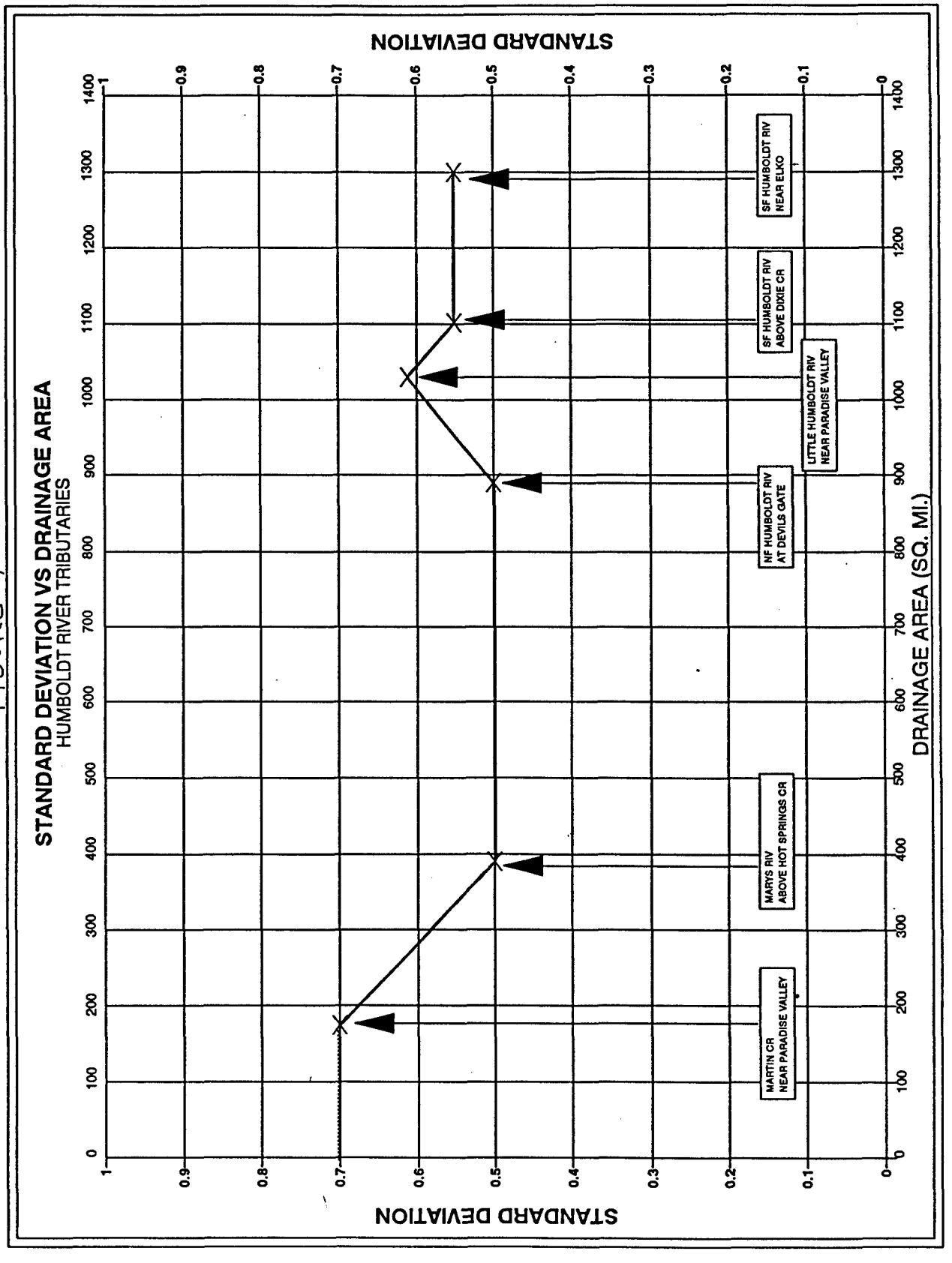


FIGURE 7


STANDARD DEVIATION VS DRAINAGE AREA
HUMBOLDT RIVER TRIBUTARIES
STANDARD DEVIATION
DRAINAGE AREA (SQ. MI.)
0
100
200
300
400
500
600
700
800
900
1000
1100
1200
1300
1400
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1
MARTIN CR
NEAR PARADISE VALLEY
MARYS RIV
ABOVE HOT SPRINGS CR
NF HUMBOLDT RIV
AT DEVILS GATE
LITTLE HUMBOLDT RIV
NEAR PARADISE VALLEY
SF HUMBOLDT RIV
ABOVE DIXIE CR
SF HUMBOLDT RIV
NEAR ELKO

10-, 50-, 100-, and 500-year outflow hydrographs of the Southside Wash Detention Dam. Figure 12 contains the rainfall peak flow frequency curves of Metzler, Southside (inflow and outflow), and Panorama Wash.

FIGURE 8

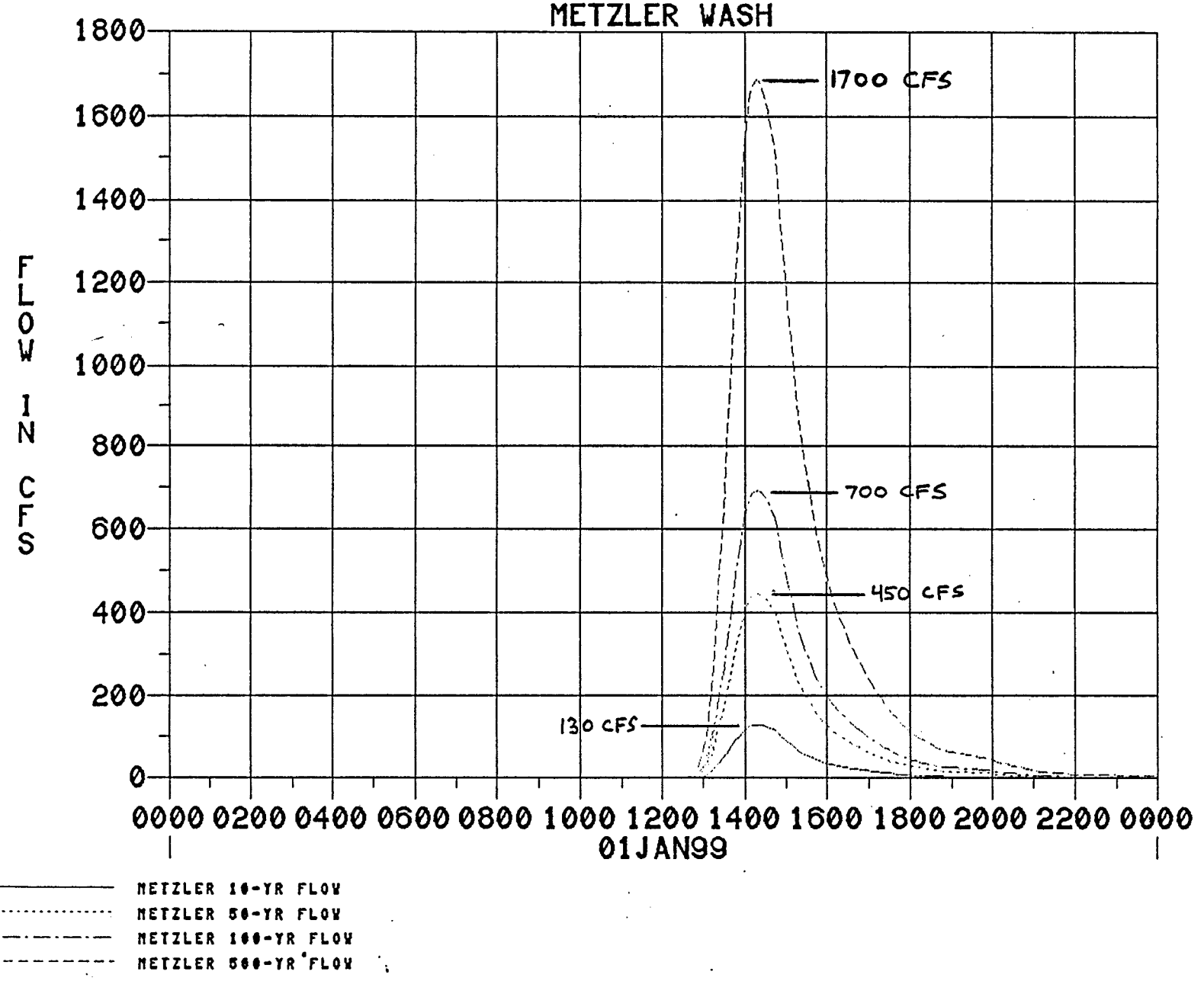

METZLER WASH
1800
1600
1400
1200
1000
800
600
400
200
0
FLOW IN CFS
1700 CFS
700 CFS
450 CFS
130 CFS
0000 0200 0400 0600 0800 1000 1200 1400 1600 1800 2000 2200 0000
01JAN99
METZLER 10-YR FLOW
METZLER 50-YR FLOW
METZLER 100-YR FLOW
METZLER 500-YR FLOW

FIGURE 9

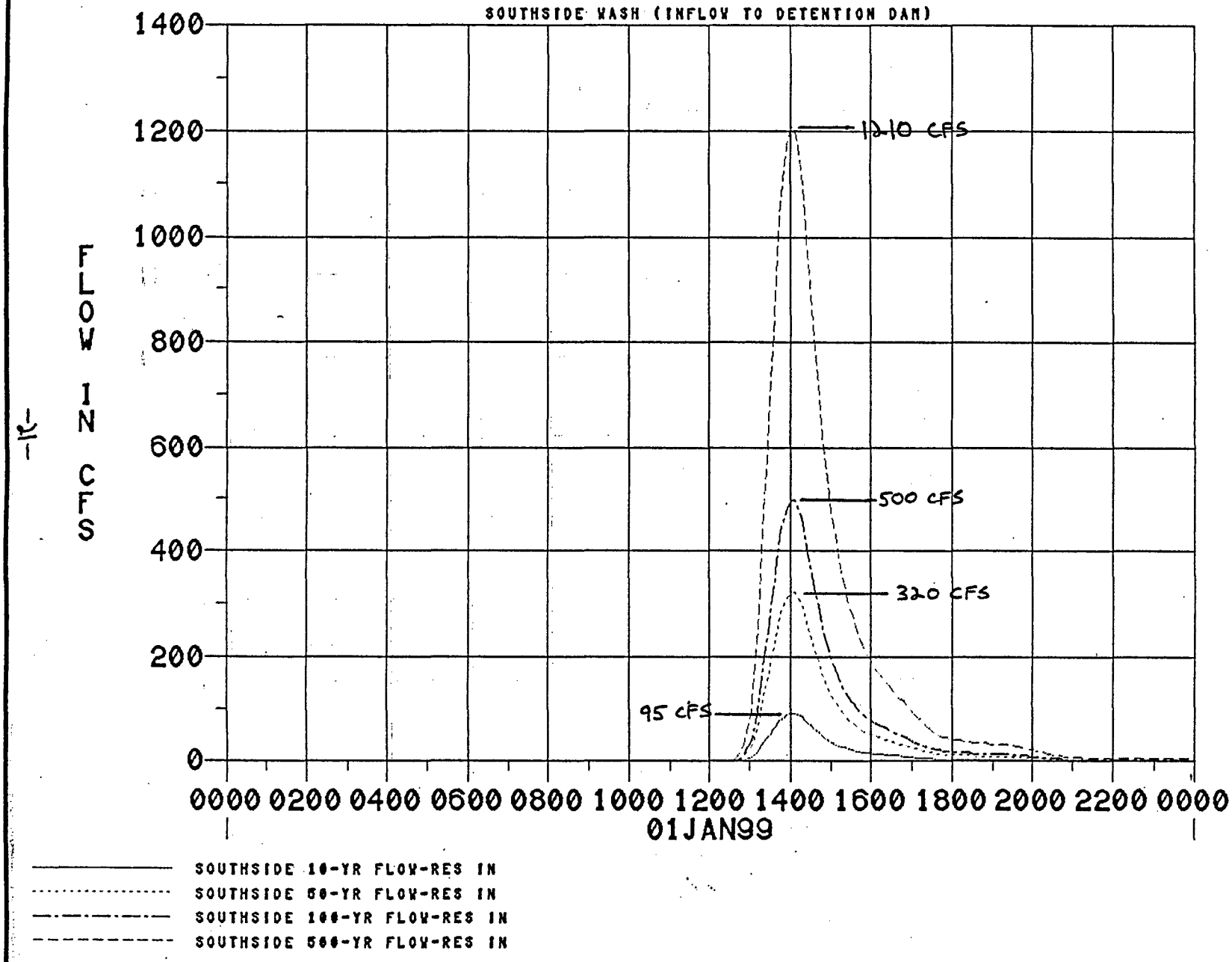

SOUTHSIDE WASH (INFLOW TO DETENTION DAM)
FLOW IN CFS
1400
1200
1000
800
600
400
200
0
1210 CFS
500 CFS
320 CFS
95 CFS
0000 0200 0400 0600 0800 1000 1200 1400 1600 1800 2000 2200 0000
01JAN99
SOUTHSIDE 10-YR FLOW-RES IN
SOUTHSIDE 50-YR FLOW-RES IN
SOUTHSIDE 100-YR FLOW-RES IN
SOUTHSIDE 500-YR FLOW-RES IN

FIGURE 10

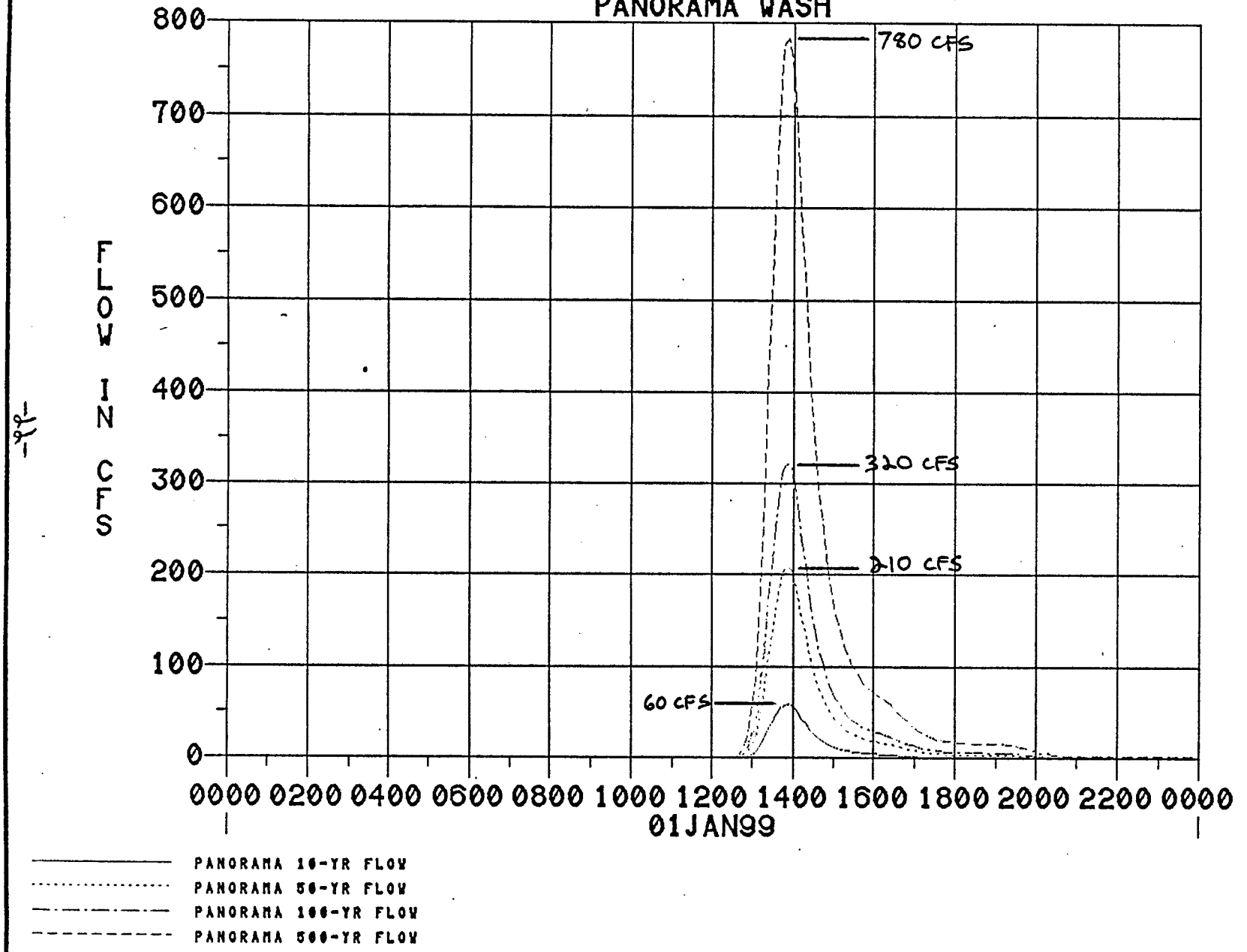
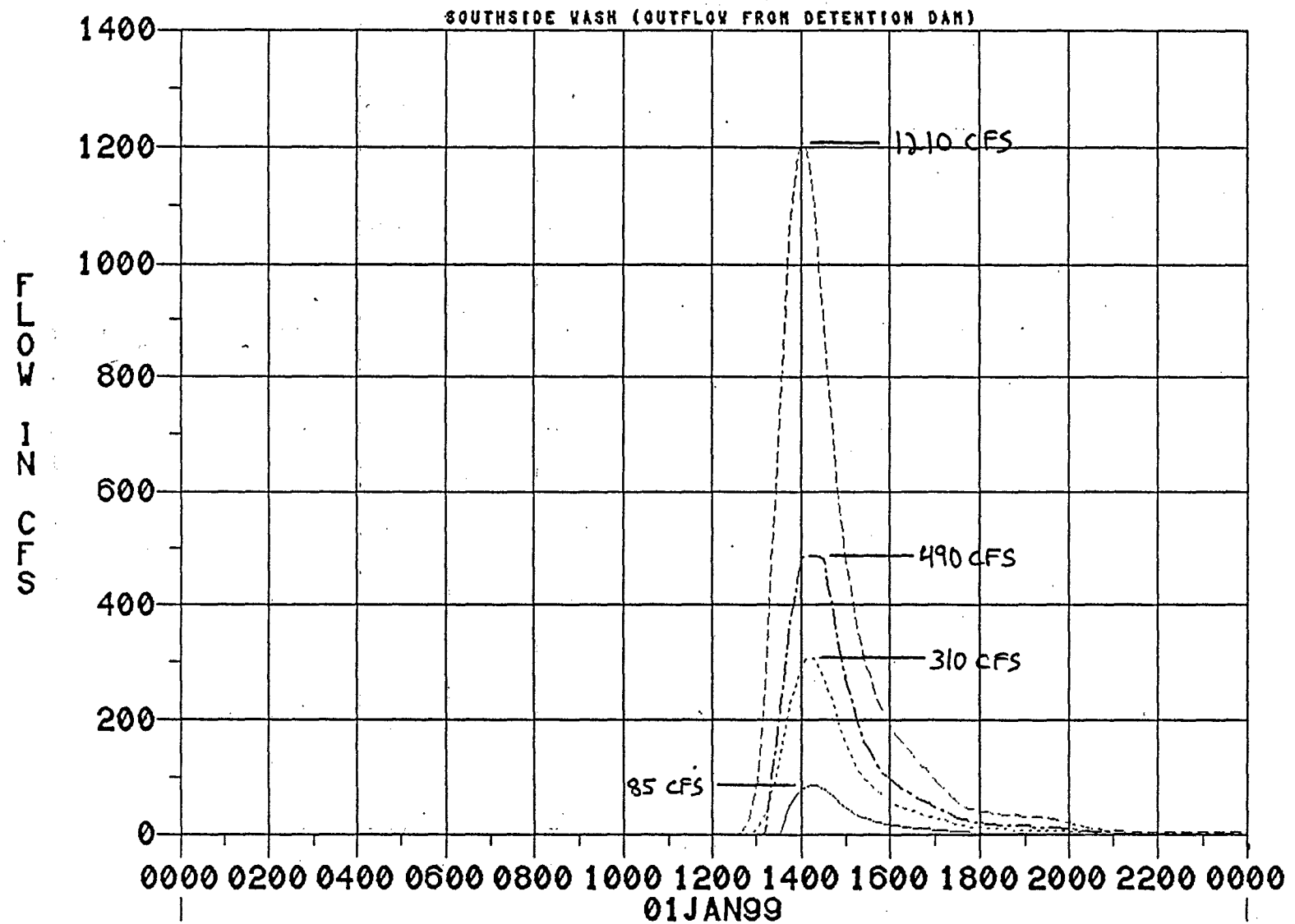

PANORAMA WASH
FLOW IN CFS
800
700
600
500
400
300
200
100
0
780 CFS
320 CFS
210 CFS
60 CFS
0000 0200 0400 0600 0800 1000 1200 1400 1600 1800 2000 2200 0000
01JAN99
PANORAMA 10-YR FLOW
PANORAMA 50-YR FLOW
PANORAMA 100-YR FLOW
PANORAMA 500-YR FLOW

FIGURE 11


SOUTHSIDE WASH (OUTFLOW FROM DETENTION DAM)
FLOW IN CFS
1400
1200
1000
800
600
400
200
0
1210 CFS
490 CFS
310 CFS
85 CFS
0000 0200 0400 0600 0800 1000 1200 1400 1600 1800 2000 2200 0000
01JAN99
SOUTHSIDE 10-YR FLOW-RES OUT
SOUTHSIDE 50-YR FLOW-RES OUT
SOUTHSIDE 100-YR FLOW-RES OUT
SOUTHSIDE 500-YR FLOW-RES OUT

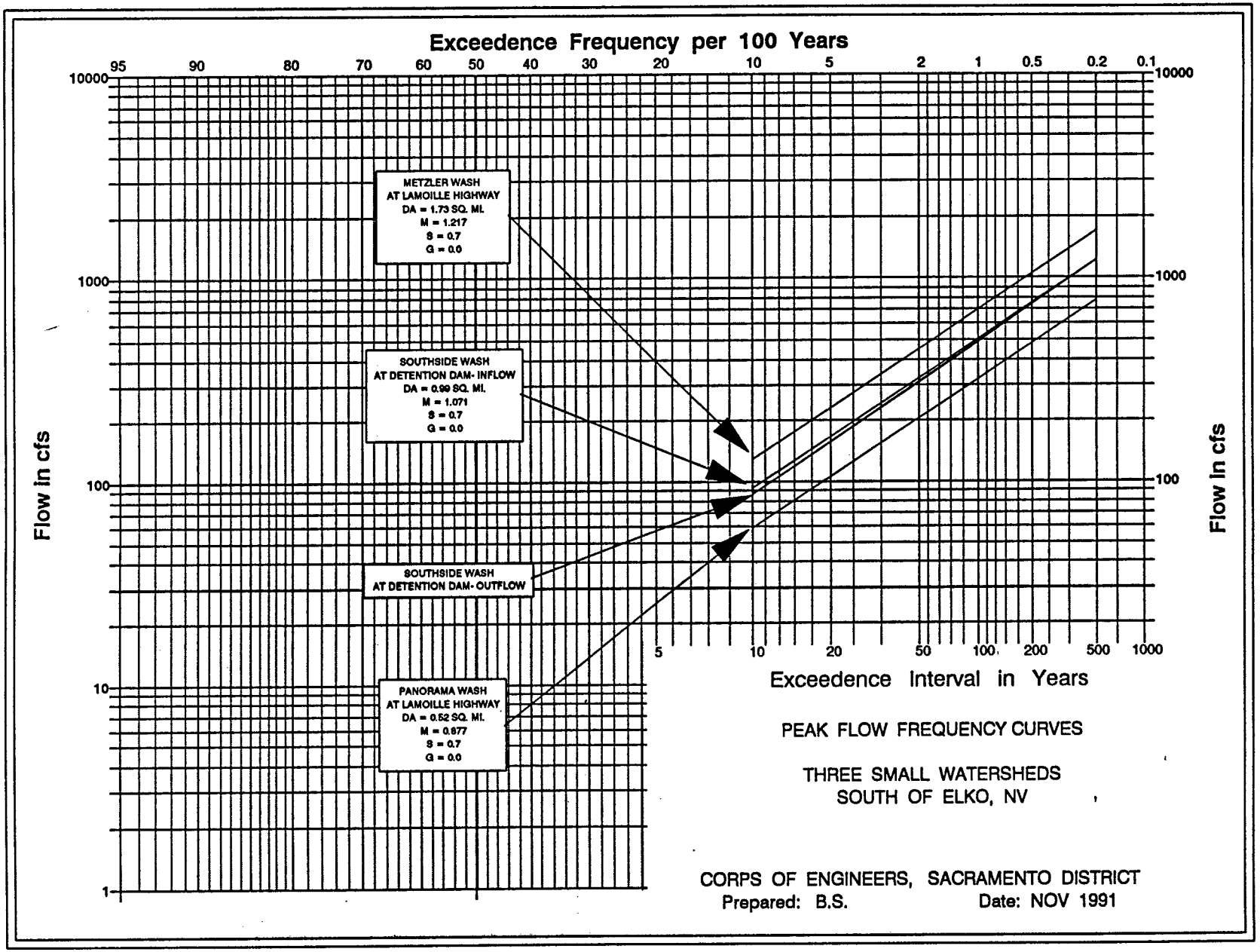

Exceedence Frequency per 100 Years
95
90
80
70
60
50
40
30
20
10
5
2
1
0.5
0.2
0.1
10000
1000
100
10
1
Flow in cfs
METZLER WASH
AT LAMOILLE HIGHWAY
DA = 1.73 SQ. MI.
M = 1.217
S = 0.7
G = 0.0
SOUTHSIDE WASH
AT DETENTION DAM- INFLOW
DA = 0.99 SQ. MI.
M = 1.071
S = 0.7
G = 0.0
SOUTHSIDE WASH
AT DETENTION DAM- OUTFLOW
PANORAMA WASH
AT LAMOILLE HIGHWAY
DA = 0.52 SQ. MI.
M = 0.877
S = 0.7
G = 0.0
5
10
20
50
100
200
500
1000
Exceedence Interval in Years
PEAK FLOW FREQUENCY CURVES
THREE SMALL WATERSHEDS
SOUTH OF ELKO, NV
CORPS OF ENGINEERS, SACRAMENTO DISTRICT
Prepared: B.S.
Date: NOV 1991

FIGURE 12

CONCLUSION

Humboldt River near Elko

The rainfall and snowmelt peak flow frequency curves of the Humboldt River near Elko were updated using 53 years of peak flows at gage 10318500. The all-events peak flow frequency curve of the Humboldt River near Elko was computed by statistically combining the rainfall and snowmelt peak flow frequency curves.

The updated rainfall, snowmelt, and all-events peak flow frequency curves have 10- and 50-year flows that are greater than those flows in the 1976 Corps and 1991 Nimbus studies. The 100- and 500-year snowmelt peak flows also are greater, but the 100- and 500-year rainfall and all-events peak flows are smaller than those flows in the 1976 Corps study.

The updated rainfall, snowmelt, and all-events peak flow frequency curves can be used to evaluate potential flood control projects on the Humboldt River near Elko.

Humboldt River Tributaries near Elko

Rainfall peak flow frequency curves were developed for the Humboldt River tributaries of Metzler, Southside, and Panorama Wash using HEC-1. The frequency curves were drawn with a slope that is consistent with the slope of other Humboldt River tributary rainfall peak flow frequency curves.

A 10-, 50-, and 500-year hydrograph was developed for each wash by multiplying the 100-year hydrograph at the outlet of each wash by its peak flow ratios.

The 10-, 50-, 100-, and 500-year Southside Wash hydrographs were routed through the Southside Wash Detention Dam using HEC-1. A rainfall peak outflow frequency curve was developed from the routing results.

The 10-year peak flows of Metzler, Southside (outflow), and Panorama Wash are 130 cfs, 85 cfs, and 60 cfs, respectively. The Corps of Engineers should not consider potential flood control projects on the washes because the 10-year peak flows are substantially less than 800 cfs.

Supplemental Data to Hydrology Section Office Report

Peak Snowmelt Flows for Humboldt River Tributaries

Panorama wash, Metzler Wash and Southside Wash

100-YEAR SNOWMELT PEAK FLOWS
HUMBOLDT RIVER TRIBUTARIES NEAR ELKO, NEVADA

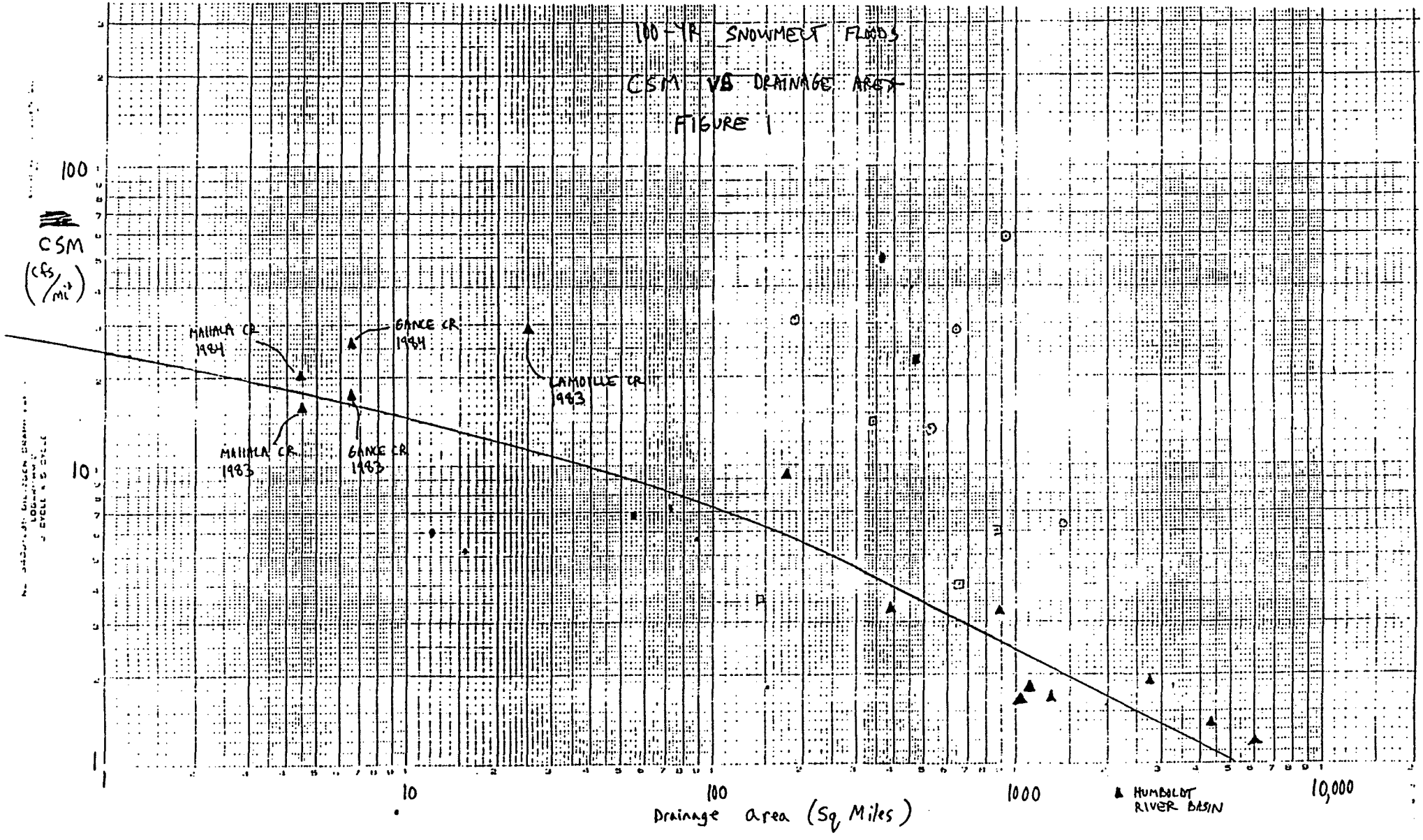
One-hundred-year snowmelt peak flows are needed to evaluate proposed flood detention basins on the Humboldt River tributaries of Panorama, Southside, and Metzler Wash. The 100-year snowmelt peak flows were estimated using Figure 1.

Figure 1 is a plot of csm versus drainage area for 100-year snowmelt floods in the Humboldt River Basin. Figure 1 indicates that Panorama Wash (drainage area= 0.5 sq mi), Southside Wash (drainage area= 1.0 sq mi), and Metzler Wash (drainage area= 1.7 sq mi) have csm values of 27, 24.5, and 22, respectively.

The 100-year snowmelt peak flows were computed as follows:

Panorama Wash	27 x 0.5 = 13.5 cfs (use **15** cfs)
Southside Wash	24.5 x 1.0 = 24.5 cfs (use **25** cfs)
Metzler Wash	22 x 1.7 = 37.4 cfs (use **40** cfs)

The computed 100-year snowmelt peak flows can be used to evaluate proposed flood detention basins on Panorama, Southside, and Metzler Wash.


100-YR SNOWMELT FLOODS
CSM VS DRAINAGE AREA
FIGURE 1
100
10
1
CSM
(cfs/mi²)
MALHEUR CR 1984
GANCE CR 1984
LAMOILLE CR 1983
MALHEUR CR 1983
GANCE CR 1983
10
100
1000
10,000
Drainage area (Sq Miles)
HUMBOLDT RIVER BASIN

WASHOE VALLEY, NEVADA at ELKO

OFFICE REPORT

GEOTECHNICAL RECONNAISSANCE

OCTOBER 1991
APRIL 1992

ATTACHMENT TWO

CESPK-ED-G (1105-2-10a) **24 OCTOBER 1991**

RECONNAISSANCE REPORT

SUBJECT: Proposed Section 205 field reconnaissance of Humboldt River Levees - Washoe Valley, Elko, Nevada.

Introduction. On 23 October 1991, I conducted a field reconnaissance evaluation of the subject levees. I was accompanied by Bob Hahne of the Colorado/Great Basin branch. The evaluation and this report respond to Work Order Request No. AA177-92-4A, dated 17 October 1991. The reader is referred to Figure 1 for all locations described in this report. Copies of photos taken during the trip will be sent to Colorado/Great Basin branch under separate cover.

Background. In 1981 a construction project was undertaken to relocate two railroad lines within the city of Elko, Nevada. The lines previously passed through the heart of the growing city. They were moved to the southwest, adjacent to the Humbolt River. About 4000 feet of the river was straightened to accommodate the railroad route. The railroad embankment serves as the right bank river levee, looking downstream. A new levee along the left bank was also built as part of this project. The left bank levee is lower and, in some areas, less substantial than the railroad embankment. There is about 800± feet of the left bank levee which is of particular concern. This critical reach is located at the upstream (northeast) end of the project, downstream and adjacent to the 12'th street bridge embankment.

Bob provided the following materials for use in preparing this report:

1. Preliminary HEC-2 output for two cross sections, field surveyed near the pedestrian and 5'th street bridges.
2. A large aerial photograph of Elko at an approximate scale of 1"=300'.
3. Selected design drawings from the City of Elko, Railroad Relocation Project showing the new alignment, relocated channel profile and typical relocated channel cross sections.

The preliminary HEC-2 output for the 100-year flood event indicates about two feet of freeboard at the pedestrian bridge and about one foot of freeboard at the 5'th street bridge. Flow

velocity ranges between six and seven feet per second.

Conclusions. Most of the left bank levee appears to be constructed of adequate materials, with adequate top width, slopes and slope protection to withstand high flood flows of short duration. About 800 feet of the left bank levee at the upstream end of the study reach is constructed of inadequate materials with inadequate top width, slopes and slope protection to resist high flood flows. This reach will require expansion or reconstruction. The right bank railroad embankment appears to be constructed according to the design drawings. Throughout the study reach, the levee freeboard allowance appears to be inadequate.

Recommendations. The following recommendations should be implemented during the feasibility stage of this study. The water surface profile adopted for design and accurate surveys showing the existing top of levee elevation are required before an assessment of the levee adequacy can be completed. It is recommended that a freeboard criteria of four (4) feet be adopted throughout the study reach. This recommendation is in agreement with EM 1110-2-1913, Design and Construction of Levees.

Field explorations, sampling and laboratory testing are recommended to more accurately define the subsurface conditions, soil types and engineering properties. This information will be required to more accurately determine the extent of levee enlargement or reconstruction and to identify the preferred borrow source(s).

Field Observations. The project was logically divided into three reaches for the purpose of documenting field observations. The upstream reach (Reach 1) extends from the 12'th street bridge, downstream to the pedestrian bridge. The middle reach (Reach 2) extends from the pedestrian bridge, downstream to the 5'th street bridge. The downstream reach (Reach 3) extends from the 5'th street overcrossing to the end of the left bank levee.

Reach 1. The first 800± feet of the left bank levee is inadequate to contain high flows. The cross section is narrow, characterized by a top width of 8 to 10 feet and side slopes which appear to be nearly 1V:1H. The levee material as observed at the surface is predominantly silt with a small amount (perhaps 10% to 20%) of fine sand. Some parts of this reach also

contain some fine gravel. Fine grained, cohesionless soils such as these are highly erodible and with the steep slopes and narrow cross section, this section of levee is highly susceptible to seepage and possible failure due to piping or sloughing during high flood flows.

There is a thin layer of ungraded riprap low on the riverside slope. This layer may adequately protect the levee during low to moderate flows; however, high flows would overtop the slope protection by four to five feet and readily erode the levee.

There is evidence that this reach of levee is uncompacted. At the upstream end, which abuts to the 12'th street overcrossing embankment, the levee crown is low. There is a well-worn path leading over the levee at this point. The grade loss may be due to settlement, or possibly the area was never built to the same grade as the rest of the levee. Conversations with city employees present during construction provided no insight into the construction history of this levee.

This so called "critical" reach of the left bank levee requires significant modification to adequately contain high flood flows. To make the reach comparable to the rest of the left bank levee, it needs to be built up and out to establish a 12-15 foot wide crown, 1V:4H waterside and landside slopes, 4 feet of freeboard above the projected 100-year water elevation, and waterside slope protection up to the 100-year flood water elevation. These modifications assume that soil borings and subsequent laboratory testing of soil samples will reveal the existing levee and foundation to be adequate as a base for new construction. It is conceivable that this reach of levee may require total reconstruction to meet Corps criteria.

The remaining length of Reach 1 consists of a more substantial levee. The top width is 12 to 15 feet with slopes of 1V:3H to 1V:4H on both sides. The levee height is 10 to 15 feet at the land side. Materials in this reach, as observed at the surface, are sand and sand with gravel. There is a thin layer of ungraded riprap low on the riverside slope which may adequately protect the levee during low to moderate flows. Slope protection was lacking on the left abutment of the pedestrian bridge.

Typically, bridge abutments intrude on the channel and local flow velocities are high. This, combined with the critical function of a bridge abutment usually dictate slope protection be present. This, however, is an overcrossing for pedestrians only and the channel is not restricted by an abutment fill. Although some erosion is likely to occur during a 100-year flood

event; adding slope protection in this area does not appear necessary.

Reach 2. This reach is characterized by a levee with a top width of 12 to 15 feet, slopes of 1V:3H to 1V:4H, and land side height of 3 to 5 feet. As in Reach 1, the left bank levee typically includes a wide berm or overflow area which sets the levee back from the main channel about 100 feet. In the downstream 1/3 of this reach, the levee turns away from the main channel, increasing the levee setback to about 200 feet. Then, the levee turns back in toward the channel because of the restriction of the 5'th street bridge. Visually, the 5'th street overcrossing is the narrowest point in the proposed project; although, there is still a berm area about 75 feet wide under the bridge. The bridge abutments are well protected from erosion by a concrete lining. The levee slope is protected by a thin layer of ungraded riprap placed low on the slope. The riprap is not present where the levee is far from the main channel (say more than 100 feet). Deletion of slope protection in these areas is justified since the flow velocity will be substantially less than the projected 6 to 7 fps at the bridges. Except for the inadequate, estimated freeboard, the left bank levee in this reach appears adequate for high flood flows.

Reach 3. The observations made for Reach 2 also apply to Reach 3, except the width of the berm area is consistently about 150 feet. Because of this setback, there is no riprap slope protection in this reach. Except for the inadequate, estimated freeboard, the left bank levee in this reach appears adequate for high flood flows.

Right Bank Railroad Embankment. A detailed inspection of the railroad embankment was not performed; however, it was viewed from either end of the proposed project for general compliance with the design drawings. The drawings show that the 100-year flood water elevation encroaches on the rail ballast. This material is highly pervious and is designed for free transport of water. The railroad embankment may not have been intended to hold back water at this level. The railroad embankment is backed up at the 5'th street bridge by a narrow levee about 5 feet high and 5 feet wide at the crown. This levee will provide adequate freeboard above the railroad embankment but it is not known if this levee extends the entire reach or is only located at the bridge or bridges. A more detailed evaluation could be performed during feasibility studies.

Potential Borrow Sources. City of Elko personnel identified two potential levee borrow sources. These are both located near the downstream end of the proposed project. The haul

distance to the extreme upstream end of the project would not exceed 1.5 miles.

One potential borrow source is on city property. The soil observed on this property is fine grained and cohesionless. It would likely classify as silt with sand. This is undesirable material for levees. It appears as if this source may have been used to construct the critical section of Reach 1 described earlier. Non-cohesive silt is highly erodible and sensitive to small changes in water content. This sensitivity requires strict construction control of water to achieve proper compaction. A soil with more sand would be easier to construct and would be less susceptible to erosion; although, it would be highly permeable. A soil with a small percentage of cohesive fines (clay) would also be easier to construct, resistant to erosion and less permeable.

An adjacent parcel of land owned by the Bureau of Land Management (BLM) was also observed. Soil at this location appeared to be more cohesive than that observed on the city-owned property. It may classify as either clay with sand or clayey sand. At this time, soil from the BLM property would be preferable for levee construction.

Subsurface exploration, sampling and laboratory testing of soil from these areas would be required in the feasibility phase of this project to more accurately define the soil types and engineering properties.

City of Elko personnel stated that the borrow source used for the existing riprap slope protection was still available. Due to time constraints, the riprap borrow source was not visited on this trip.

Upstream Drainage Collector. The WOR stipulates that a drainage collector system at the upstream end of the proposed project be inspected for adequacy. This system is a collector trench located between an apartment complex and 12'th street on the left side of the river. It appears to collect surface runoff from the apartment parking areas and may be fed by an underground drainage network as well. Apparently, the trench overflows during heavy cloud burst type storms. The system is controlled at its downstream end by three pipes which transport the water through the levee, into the river channel. To increase the capacity of the system would involve either increasing the size or number of pipes passing through the levee. Alternatively, the holding capacity of the trench could possibly be increased to contain water while the pipes drain it off. The trench is located along the toe of the 12'th street embankment fill; therefore,

the trench need only be modified on one side. There is adequate open space to construct a circular holding basin; although, the disposition of the property is not known. The simplest possible solution would be to simply raise the left side of the trench by means of a small levee.

Neither the history nor the hydrology of the system is known; therefore, a more specific evaluation of adequacy cannot be made.

Matthew L. Allen

MATT ALLEN
Civil Engineer
Soil Design Section

cc: Civ Proj Br
Civ Proj Sec A (Fakes, orig w/ photos)
Geotech Br
Soil Des Sec
Col/Great Basin Br (Hahne)

CESPK-ED-GS (1110-2-1150a) 27 April 1991

RECONNAISSANCE REPORT (Supplemental)

SUBJECT: Washoe Valley, Elko, Nevada - Supplemental Field Reconnaissance of Humboldt River Levees.

1. Background. On 3 March 1992, I participated in a site visit to the subject project to obtain additional information to supplement an earlier reconnaissance report, dated 24 October 1991. The visit and this report respond to WOR No. AA177-92-5A, dated 2 March 1992. Specifically, this report provides an update to the October report; includes descriptions of the geology and seismicity (provided by Geology Section); proposes a recon level design for rehabilitation of the levee; and provides a scope of explorations and feasibility study cost estimate.

2. Right Bank Railroad Embankment. A detailed inspection of the railroad embankment and the concrete sound wall was performed. Design drawings indicate that the 100-year flood water elevation encroaches on the railroad ballast. This material will not hold back water since it is designed for free transport of moisture. The only restriction to water once it has reached this elevation is a concrete sound wall. The wall is constructed of concrete masonry blocks, in sections about 8-feet tall and 20 feet long. According to the design drawings, the wall is founded on a 7-foot wide by 10-inch thick concrete footing and tied to the foundation with #3 rebar. Construction joints between the wall sections were observed to be as wide as two inches. The sound wall may retain some water, but not without substantial leakage through the joints. It may stand up to about two feet of water, but should not be relied on for more than this.

3. POTENTIAL LEVEE BORROW. The site of the original levee borrow source was visited. It was described by city personnel as an old sand and gravel quarry operation. The area is now occupied by several industrial/commercial businesses. Portions of the area may still be accessible and this possibility should be pursued in feasibility level investigations.

4. RIPRAP BORROW. The riprap source for the previous project was observed from a large distance. Muddy road conditions on this day prevented a closer inspection. City personnel indicated they knew of no reason this operation could not be resumed for future work.

5. SOIL CONDITIONS. Boring logs from construction of the 12'th Street bridge were reviewed by Geology Section and along with observations at the site were used to provide the following descriptions. The foundation material for the south end of the bridge and the levee at the 12'th Street location consists of a red-brown sandy silt (ML) which is stiff, grading to very stiff at depth. The silt is interlayered with silty sand and at the time of drilling was wet. It is overlain by a grey-brown sandy gravel (GP) and grey-brown sand (SP). The sandy gravel is dense and was wet to saturated at the time of drilling. The sand was loose and moist. The soil cover in the area consists of a light brown sandy silt (ML) which is loose and dry.

6. SEISMICITY. Elko is located in the eastern half of the Northern Nevada Seismic Zone (Husband, J., 1975) which is an area of approximately 73,155 square kilometers and is defined as a zone characterized by a very sparse distribution of earthquake epicenters. A compilation of data shows that in the interval from 1932 through 1972, there were a total of 19 recorded events for which magnitudes were determined on 15. Of these, 14 events were ≥ M4.0 and none were ≥ M6.0. In the interval from 1852 through 1931, 35 events were recorded but magnitudes were determined on only 8. Of these 8 events, all were ≥ M4.0 and < M6.0.

Recurrence curves were calculated from the compiled data and the following parameters were determined for a common area of 1000 square kilometers:

The average annual number of events with magnitude ≥ 4.0 - .0064

The average annual number of events with magnitudes ≥ 6.0 - .0002

The magnitude of the earthquake expected once in 100 years - 3.7

The expected time for the recurrence of a magnitude 7.0 shock - 17,498 years.

The closest fault thought to be capable of a M7.0 event is located at the northwestern base of the Cortez Mountains approximately 35 miles (56 km) southwest of Elko (Husband, J., 1976).

7. REHABILITATION DESIGN. The critical 800 - 1000 foot section of left bank levee, located downstream from the 12'th Street bridge should be rebuilt or built up in accordance

with the section provided as Figure 1. The exploration and testing program proposed below should determine if the existing levee is adequate to be built upon or will need to be removed. As stated in the previous Reconnaissance Report, the freeboard of the existing levee system in general appears inadequate. I recommend that when water surface profiles and levee crest elevations are finalized, that a freeboard allowance of four feet be adopted to meet the criteria of EM 1110-2-1913, Design and Construction of Levees. This may require some build-up of existing levees beyond the critical reach.

8. EXPLORATIONS. For feasibility studies, it is proposed to conduct field explorations consisting of 10 rotary drill holes through existing left bank levees and 3-4 backhoe pits in each of three potential levee borrow sources. Four borings will be placed in the so-called critical reach. The remaining borings will be spaced logically over the remainder of the left bank project levee. Drilling will be by hollow-stem auger with "continuous" Standard Penetration Testing (SPT), that is, one SPT for every 2½-feet of hole. All samples from the SPT drive spoon will be field classified and bagged for the lab by District personnel. The borrow area backhoe pits will be logged and bulk sack samples collected for the lab by District personnel. Geology Section has provided the following cost estimate to administrate the contract for field explorations.

Hired Labor (HL)	$6,100
Other Expenses (OE)	$2,900
Contract Costs (Drilling)	$10,000
	$19,000

9. LAB TESTING. Laboratory testing of soils will be conducted at the South Pacific Division (SPD) lab in Sausalito, CA. Primary testing will consist of soil classification, particle-size analysis and plasticity characteristics. The cost of this program is estimated at $6,000. This is considered a rudimentary program and it is probable that additional testing, and possibly additional explorations will be required to prepare Plans and Specifications.

10. SOIL DESIGN SECTION. Soil Design Section effort toward a feasibility report is anticipated to involve an engineer (≈1 week), draftsman (≈2 weeks), and section administration (≈20%). This effort is estimated at $3,000 (HL).

If you have any questions or need additional information, please call ext. 7171.

Matthew L. Allen

MATT ALLEN
Soil Design Section

cc: Civ Proj Br.
Civ Proj Sec A (Fakes) ✓
Geotech. Br.
Soil Des Sec (Orig)
Geology Sec (Boyd)

SUBJECT: HUMBOLOT RIVER - WASHOE VALLEY, ELKO NV.	COMPUTED BY: NAT ALLEN SOIL OGS SEC CHECKED BY:	DATE: 10 APR 92 DATE:	FILE NO. 1/1 SHEET NO.

This proposed section is based on a surficial, field reconnaissance only. It is recognized that additional knowledge of soil properties may impact the design. Also, restrictions from such factors as real estate acquisition, impact on hydraulics and hydrology are not known at this time.

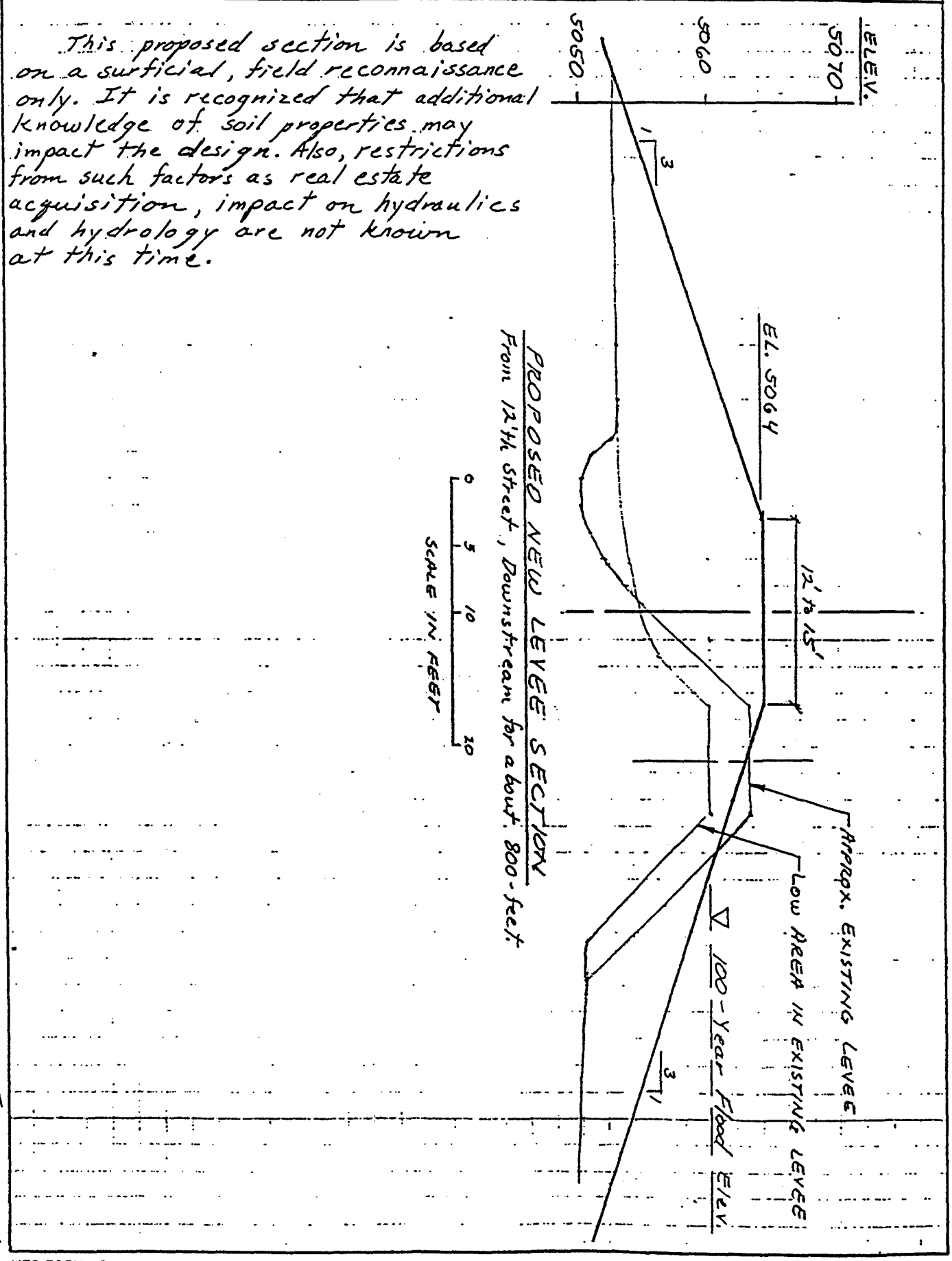
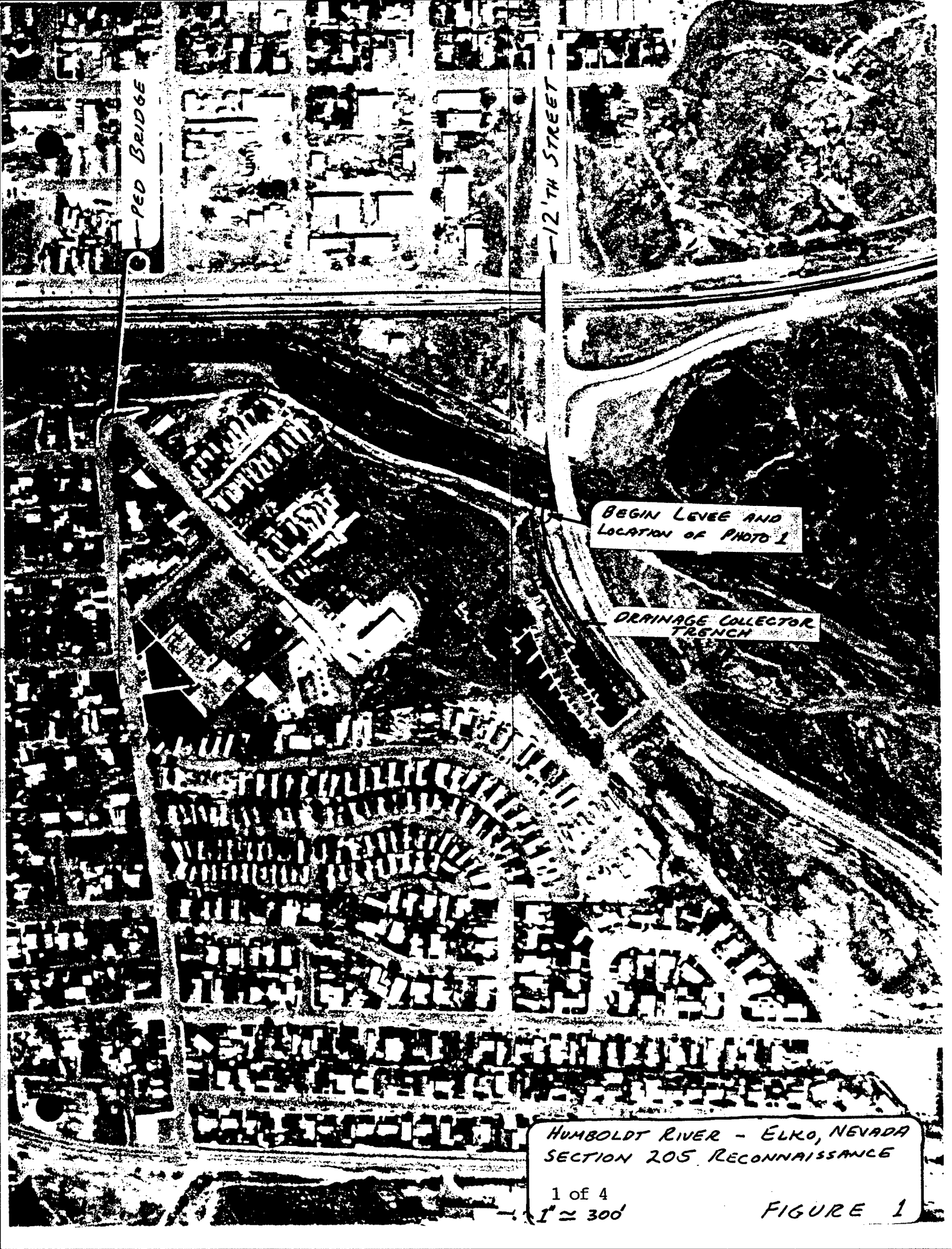


FIGURE 1

FIGURE 1

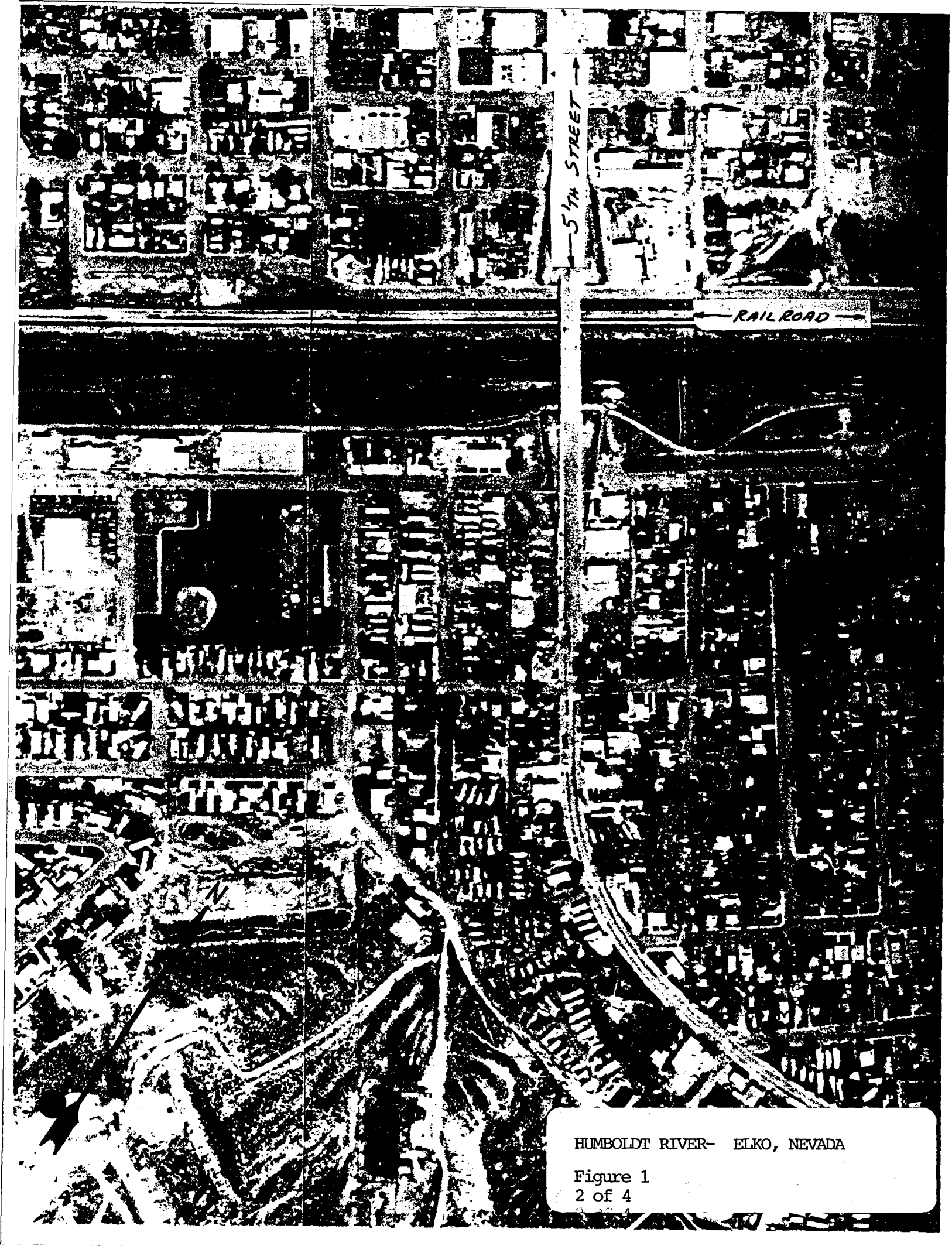


HUMBOLDT RIVER - ELKO, NEVADA
SECTION 205 RECONNAISSANCE

1 of 4

1" ≃ 300'

FIGURE 1



HUMBOLDT RIVER- ELKO, NEVADA

Figure 1
2 of 4

HUMBOLDT RIVER

Figure 1
3 of 4

HUMBOLDT RIVER
Figure 1

WASHOE VALLEY, NEVADA at ELKO

OFFICE REPORT

EXISTING LEVEE EVALUATION

APRIL 1992

ATTACHMENT THREE

25 March 1992
Revised 17 April 1992

Office Report

Subject: Existing Levee Evaluation, Washoe Valley, Elko, Nevada

Reference: Policy Guidance Letter No. 26, Benefit Determination Involving Existing Levees, dated 23 December 1991

1. **General:** All analysis is qualitative and based on field observations and examination of selected design drawings of the existing Railroad Relocation (dated 2/19/80) and 12th Street Bridge (dated 7/78). The highest flow experienced by this relocated channel has been indicated by Planning Division, Sacramento District, to be 7,100 cfs. No overbank damages were experienced during this event. The referenced design drawings for the 12th street bridge indicated a 100 year design flood of 12,500 cfs and a design flood elevation in the vicinity of the bridge of 5059 (3.3 feet of adjoining levee freeboard). The USCE 100 year flood event is 12,100 cfs.

2. **Evaluation:**

a. **Left Bank Levee, 12th Street downstream approximately 4500 feet.-**

The most critical section of the left bank levee is just downstream of the 12th street bridge. This critical section extends approximately 800 feet downstream from the 12th street bridge. The existing levee cross section is inadequate, the crown width is narrow, approximately 10 feet, and side slopes appear to be nearly 1V on 1H. The levee crown elevation is approximately 5 to 10 feet higher than adjacent ground. Approximately 100 feet downstream of 12th street, the levee crown is approximately 3 feet lower than the crown of the remainder of the existing levee in this section. This low spot is about 30 feet wide and either may have been purposely constructed low (the City of Elko City Engineer was questioned and had no information) or may be attributable to heavy foot and bicycle traffic combined with wind erosion and possible overtopping of the immediately adjacent interior drainage channel inlet. The City of Elko performed a limited survey of this section and the results indicate the existing levee crown elevation to be approximately 5063.0 feet msl and the low point of this levee section described above to be elevation 5060 ft. msl. On the waterside slope of the existing levee is ungraded riprap slope protection. Design drawings indicate this layer should be approximately 1.75 feet in thickness. This riprap protection extends from approximately 4 feet below the crown of the existing levee to the waterside toe of the levee. The existing levee surface material appears to be predominantly silt with a small amount (10-20 percent) of fine sand. Fine grained, cohesionless soils such as these are highly erodible and with the existing steep slope and narrow cross section, this section of levee is highly susceptible to seepage and possible failure or sloughing during high flood flows. High flows would overtop the existing slope protection and readily erode the levee. The physical effectiveness of this levee is uncertain at water surface elevations exceeding the existing riprap elevation

and will overtop at the previously mentioned low section described above.

The Probable Non-failure Point (PNP), highest vertical elevation on the levee such that it is highly likely that the levee would not fail if the water surface were to reach this level, appears to be the point at which the levee is under minimal stress, or at or near adjacent natural ground elevations, an average of 6 feet below the crown of the levee, or approximately elevation 5057 ft m.s.l, just downstream of the 12th Street bridge. The Probable Failure Point (PFP), the lowest vertical elevation on the levee such that it is highly likely that the levee would fail, appears to be approximately 4 feet below the existing levee crest elevation or approximately 1 foot below the levee crown elevation near the critical low section described above (elevation 5059 at this location, approximately the top of the existing riprap). Certain failure (overtopping) will be reached at the vertical low point (three feet below the levee crown elevation, elevation 5060) described above. The historical high water elevation passed by this levee, corresponding to approximately 7,100 cfs, is about elevation 5058, at this section. Projecting highly likely levee failure at water surface elevations above the historical high water elevation (5058) appears reasonable.

The remainder of the levee section along the left bank from about 800 feet downstream of the 12th street bridge, approximately 3700 feet, is more substantial in cross section and crown widths are approximately 12-15 feet. For most of the section, water-side berm areas, 150 to 200 feet in width, exist between the river and the levee (from about 1200 feet downstream of the 12th street bridge to the end of the left bank levee). The riprap along the left bank is discontinued approximately where the wide berms start, due to low overbank velocities. The levee between the pedestrian bridge (approximately 1200 feet downstream of the 12th street bridge) and the 5th street bridge (approximately 2400 feet downstream of the 12th street bridge) averages about 4 to 5 feet in height. Downstream of 5th street the levee averages between 2 to 4 feet in height. The most critical section of this levee would appear to be just downstream of the pedestrian bridge for 100 to 200 feet. This section is the narrowest river cross section along this reach. The PNP for this reach should be the point at which the existing levee is under minimal stress, approximately the existing adjacent ground elevation or approximately 5 feet below the crown elevation of the levee. The PFP for this section would probably be at a point about 1-2 feet below the crown elevation of the existing levee.

Hydrology studies indicate that the flooding in the Elko area is caused by two distinct hydrologic events. One, a spring snowmelt which provides sustained flood flows in the Humboldt River. The second event is the brief cloudburst event. This event occurs in the foothills above the Humboldt River left bank residential area and creates sharp peaking runoff (peak inflow reached in approximately 5 hours) that is not controlled by the current city of Elko interior drainage system. The ponding of the tributary inflow on the landside of the levee along the right bank levee will stress the existing embankment due to seepage and possible piping of the existing sections. The PNP point for the left bank levee again is the point of minimum stress, the existing adjacent ground elevation. The PFP again would be approximately 1-2 feet

below the existing levee crown elevation.

2. **Right Bank Levee, 12th Street downstream to Bullion St.-**

The right bank embankment consists of a railroad embankment (two sets of tracks, railroad embankment section approximately 50 feet in width), approximately 30 foot wide earthen access road, and eight foot sound wall. The base of the sound wall is approximately 6 to 8 feet higher in elevation than the adjacent natural ground. There are two sound walls between the 12th street bridge and the pedestrian bridge (both sides of the double railroad tracks and the access road). Downstream of the pedestrian bridge the wall is only on the landside of the railroad tracks. The existing railroad track sections are approximately 100 feet from the river beginning from about 750 feet downstream of the 12th street bridge. The riverbank is riprapped to a height of approximately 6 feet, then a wide 50-60 foot berm section exists, then the railroad track embankment section is riprapped, ungraded, for height of approximately 6 to 8 feet. The ballast cross section of the railroad tracks is about 3 feet in height. The sound wall is an 8 foot high masonry block wall with a 7 foot wide foundation (approximately 2.5 feet in depth). A construction joint exists just at the base of the wall at ground level. The sound wall is designed for Seismic Zone 2 and approximately a 20 psf wind loading (Safety Factor 1.33). The wall sections are joined by a formed joint material (1/2 inch by 2 inches) to a height of about 4 to 5 feet from the base of the wall.

The PNP would be at the base of the ballast material of the existing railroad or approximately 2-3 feet below the elevation of the railroad tracks. The ballast material would not retain floodflows and would drain freely. The PFP would be approximately 2-2.5 feet above the base of the existing sound wall or approximately the same elevation as the railroad tracks. The sound wall would not retain water due to the openings present;however, would probably not fail until water was incidentally retained 2 to 2.5 feet up from the base.

Bill Fakes
Civil Projects Sec A

WASHOE VALLEY, NEVADA at ELKO

OFFICE REPORT

COST ESTIMATES

MAY 1992

ATTACHMENT FOUR

LOCATION: Washoe Valley, Nevada at Elko

ESTIMATOR: Bob Varozza DATE: May 1992

QUANTITIES: Larry Clay DATE: May 1992

ITEM: Enlarge Left Bank Levees, Humboldt River near Elko, NV

LEVEL OF FLOOD PROTECTION: 100 year

PRICE LEVEL: 1 October 1992

FIRST COST:

Acct. No.	Description	Estimated Quantitity	Unit	Unit Price	Total Cost
01	Lands and Damages			Total 01	660,000
06	Fish and Wildlife (see RE back-up attached)				
	Riparian establishment	1	Ac	8,000	8,000
				contingencies, 25%	2,000
				Total 06	10,000
11	Levees and Floodways				
	Levees				
	Mob and Demob	1	Job	15,000	15,000
	Stripping foundation, to spoil	2180	CY	2.00	4,360
	Excavation, common	1,230	CY	3.00	3,690
	Excavation, trench	140	CY	3.00	420
	Filter Cloth	5070	SY	1.20	6,084
	Embankment, from exc.	1230	CY	2.00	2,460
	Embankment, from borrow 2 miles	23600	CY	3.50	82,600
	Bedding Aggregate	2000	ton	12.00	24,000
	Riprap	5100	ton	20.00	102,000
	Seeding	5	ac	1,500	7,500

	Interior Drainage				
	Pipe drains, excav.	1730	CY	3.00	5,190
	Pipe drains, filter aggre.	870	ton	12.00	10,440
	Pipe drains, embankment	800	CY	4.00	3,200
	Culverts, 36 inch CMP	370	lf	50	18,500
	Concrete headwalls	8	Ea	1,300	10,400
	Culverts, 24 inch CMP	50	lf	36	1,800
	Flap gates, 36 in	4	Ea	2,100	8,400
	Flap gate, 24 in	1	Ea	1,500	1,500
	Trashracks	5	Ea	450	2,250
				subtotal	309,794
				contingencies, 25%	77,206
				Total 11	387,000
14	Recreation Facilities				
	Grading rec trail, 4800 lf	5300	SY	0.20	1,060
	Stabilized aggregate	1280	ton	13	16,640
	Prime coat	8	ton	400.00	3,200
	Bituminous surface course 2 inch	600	ton	38	22,800
	Signs and markings	1	Job	2,000	2,000
				subtotal	45,700
				contingencies, 25%	11,300
				Total 14	57,000
30	Engineering and Design (12 percent)				54,000
31	Construction Management (8 percent)				37,000
				Total	1,205,000

LOCATION: Washoe Valley, Nevada at Elko

ESTIMATE: Reconnaissance

ESTIMATOR: Bob Varozza DATE: May 1992

QUANTITIES: Bill Fakes DATE: May 1992

ITEM: Flood Control Detention Basin

CAPACITY: 15 Acre-feet LOCATION: Panorama Wash

PRICE LEVEL: 1 October 1992

FIRST COST:

Acct. No.	Description	Estimated Quantity	Unit	Unit Cost	Total Cost
01	Lands and Damages		Total 01		50,000
04	Dams				
	Mob and Demob	1	Job	LS	15,000
	Excavation, common and disposal (2 mi haul)	1100	CY	6.00	6,600
	Clearing and Grubbing	3	AC	2,000	6,000
	Concrete Dam, in place Roller compacted concrete	1800	CY	40.00	72,000
	Stone Protection- 3 mi haul, commercial supplier	2900	Tons	25.00	72,500
	Reshape existing channel bank	1400	SY	2.00	2,800
	Filter Cloth	1400	SY	1.50	2,100

LOCATION: Washoe Valley, Nevada at Elko
ITEM: Flood Control Detention Basin, 30 AF

	Outlet, 48 in CMP ungated	40	lf	72.00	2,880
	Trashrack	1	EA	500.00	500
				subtotal	180,380
				contingencies, 25%	44,620
				Total 04	225,000
06	Fish and Wildlife				
	Mitigation (riparian establishment)	3	Ac	8,000	24,000
				contingencies, 25%	6,000
				Total 06	30,000
30	Planning, Engineering, and Design (12 percent)			Total 30	31,000
31	Construction Management (8 percent)			Total 31	20,000
				TOTAL FIRST COST	$ **356,000**

BACK-UP TO COST ESTIMATES

CONSTRUCTION COST ESTIMATE

PROJECT: LEVEE IMPROVEMENT
LOCATION: ELKO, NEVADA
SPEC NO: ESTIMATOR: VAROZZA

SHEET: 1
DATE: 10-Jun-92
CODE: STUDY
FILE: ELK03

ACCT NO:	DESCRIPTION	ESTIMATED QUANTITY	UNIT	UNIT COST	TOTAL COST
	Price Level as of 1 October 1992				
	LEVEE ENLARGEMENT ALONG HUMBOLT RIVER				
	(Raise the left bank - 4600'and new levee 820')				
1	**LANDS AND DAMAGES**				
11	**LEVEE AND FLOODWAYS**				
	LEVEE				
	Mob and demob	1	JOB	15,000.00	15,000
	Stripping, foundation (to spoil)	2,180	CY	2.00	4,360
	Excavation, common	1,230	CY	3.00	3,690
	Excavation, trench	140	CY	3.00	420
	Filter cloth	5,070	SY	1.20	6,084
	Embankment, from exc	1,230	CY	2.00	2,460
	Embankment, borrow 2mi	23,600	CY	3.50	82,600
	Bedding aggr	2,000	TON	12.00	24,000
	Riprap	5,100	TON	20.00	102,000
	Seeding	5	AC	1,500.00	7,500
	INTERIOR DRAIN				
	Pipe drains, excavation	1,730	CY	3.00	5,190
	Pipe drains, filter aggr	870	TON	12.00	10,440
	Pipe drains, embankment	800	CY	4.00	3,200
	Culverts 36" CMP (3 sites)	370	LF	50.00	18,500
	Concrete headwalls (20cy total)	8	EA	1,300.00	10,400
	Flap gates 36"	4	EA	2,100.00	8,400
	Culverts 24" CMP	50	LF	36.00	1,800
	Flap gates 24"	1	EA	1,500.00	1,500
	Trashracks	5	EA	450.00	2,250
					0
					0
	Subtotal				309,794
	Contingencies	25	%		77,206
	TOTAL LEVEE				**387,000**
14	**RECREATION FACILITIES**				
	Grading rec trail 4800'l 10'w	5,300	SY	0.20	1,060
	Stabilized aggreagate 4"	1,280	TON	13.00	16,640
	Prime coat	8	TON	400.00	3,200
	Bitumnous surface course 2"	600	TON	38.00	22,800
	Sign and markings	1	JOB	2,000.00	2,000
					0
					0
	Subtotal				45,700
	Contingencies	25	%		11,300
	TOTAL RECREATION				**57,000**
30	**ENGINEERING AND DESIGN**	**12.0**	**%**		**53,000**
31	**SUPERVISION AND ADMINISTRATION**	**8.0**	**%**		**36,000**
	TOTAL				**533,000**

SPK FORM 56

CONSTRUCTION COST ESTIMATE — SHEET: 1

PROJECT: LEVEE IMPROVEMENT — DATE: 10-Jun-92

LOCATION: ELKO, NEVADA — CODE: STUDY

SPEC NO: — ESTIMATOR: VAROZZA — FILE: ELKO1

ACCT NO:	DESCRIPTION	ESTIMATED QUANTITY	UNIT	UNIT COST	TOTAL COST
	Price Level as of 1 October 1992				
	FLOOD CONTROL DETENTION BASIN				
	(15 acre foot 15'h 180' crest)				
	01 LAND AND DAMAGES				
	04 DAMS				
	Mob and demob	1	JOB	15,000.00	15,000
	Clearing and grubbing	3	AC	2,000.00	6,000
	Excavation (2mi disposal)	1,100	CY	6.00	6,600
	Embankment, RCC incl cement	1,800	CY	40.00	72,000
	Stone protection 36" layer	2,900	TON	25.00	72,500
	Reshape channel bank	1,400	SY	2.00	2,800
	Filter cloth	1,400	SY	1.50	2,100
	Outlet 48" CMP	40	LF	72.00	2,880
	Trashrack	1	EA	500.00	500
					0
	Subtotal				180,380
	Contingencies	25	%		44,620
	Subtotal				225,000
	Escalation to Midpoint of Construction	0.0	%		0
	TOTAL				**225,000**
	TOTAL				225,000
30	ENGINEERING AND DESIGN	12.0	%		27,000
31	SUPERVISION AND ADMINISTRATION	8.0	%		18,000
	TOTAL				**270,000**

WASHOE VALLEY, NEVADA AT ELKO

REAL ESTATE The lands required for the flood protection project consists of 7.9 acres of levee easement necessary for the repair, improvement or construction of levee along approximately 5500 feet of the left bank of the Humboldt River downstream of the 12th Street Bridge; 0.5 acres of temporary construction easements along the levee; and 0.1 acres in fee for a gravel covered parking area for recreational parking. To alleviate interior drainage flooding south of the existing left bank, a detention basin is proposed along Panorama Wash just south of Elko, requiring 7.9 acres of flowage easements and 0.3 acres of fee for construction of a small dam. The recreation alternative would require the purchase of the levee lands in fee title rather than the levee protection easement.

The land costs are as follows:

01. Lands and Damages

Levee	
Levee Easement 7.9 ac	$ 426,600
Temporary Construction Easement 0.5 ac	6,000
Relocations (PL91-646)	1,000
Contingencies 35%	151,760
Subtotal	$ 585,360
Detention Basin (Panorama Wash)	
Detention Dam 0.3 Fee ac	$ 6,000
Flowage Easement 7.9 ac	31,600
Contingenies 35%	13,160
Subtotal	$ 50,760
Recreation Plan	
Fee over Levee Easement 7.9 ac	$ 47,400
Recreation Parking 0.1 ac	6,000
Contingencies 35%	18,690
Subtotal	$ 72,090

NOTE: Only costs for levee and recreation plan were included in the final alternative cost.

ATTACHMENT E

PERTINENT CORRESPONDENCE

BOB MILLER
Governor

STATE OF NEVADA

PETER G. MORROS
Director

RONALD M. JAMES
State Historic Preservation Officer

DEPARTMENT OF CONSERVATION AND NATURAL RESOURCES

DIVISION OF HISTORIC PRESERVATION AND ARCHEOLOGY
123 W. Nye Lane, Room 208
Capitol Complex
Carson City, Nevada 89710
(702) 687-5138

September 10, 1992

Mr. Walter Yep
Planning Division
U.S. Army Engineer District
Corps of Engineers
1325 J Street
Sacramento, CA 95814-2922

ATTN: Environmental Resources Branch

SUBJECT: Washoe Valley at Elko, Nevada: Cultural Resources Overview.

Dear Mr. Yep:

The Nevada Division of Historic Preservation and Archeology reviewed the subject document. The overview adequately discusses the proposed project area.

The Division has several suggestions regarding this document and future background research for the project:

1). There are no bibliographic entries for any of the archaeological citations (eg. pg. 9 and Table 2);

2). There are some additional references germane to the project including: The Nevada Comprehensive Preservation Plan, 1991 (Nevada state plan); An Archaeological Element for the Nevada Historic Preservation Plan, 1982 (especially M.K. Rusco's chapter); and The Archaeology of James Creek Shelter, 1990 (Univ. of Utah Anthropological Paper, No. 115).

The Division concurs with the Corps of Engineers' recommendations. This office would not recommend resurvey of areas surveyed prior to 1980 under the aegis of the Nevada State Museum and/or the Nevada Archaeological Survey.

Please contact me if you have any questions concerning this correspondence.

Sincerely,

Eugene M. Hattori

Eugene M. Hattori
Archaeologist

United States Department of the Interior

FISH AND WILDLIFE SERVICE
FISH AND WILDLIFE ENHANCEMENT
RENO FIELD STATION
4600 Kietzke Lane, Building C-125
Reno, Nevada 89502-5093

May 11, 1992
File No. COE 3-6

Laurence R. Sadoff, Colonel
Sacramento District
Army Corps of Engineers
1325 J Street
Sacramento, California 95814-2922

Dear Colonel Sadoff:

Attached is the final Planning Aid Report (PAR) provided by the Fish and Wildlife Service for the U.S. Army Corps of Engineers, Sacramento District, for the Washoe Valley at Elko, Nevada, Flood Control Reconnaissance Study. It has been prepared under the authority of, and in accordance with the provisions of, the Fish and Wildlife Coordination Act (48 Stat. 401, as amended; 16 U.S.C. § 661, et. seq.). It is not intended to fulfill section 2(b) of the Fish and Wildlife Coordination Act.

Comments from your staff have been addressed in the final PAR, and alternatives have been revised to reflect current project proposals as of April 28, 1992. We look forward to working with you and your staff should this study continue into feasibility-level investigations.

If you have questions or wish to consult with us about this PAR, please contact Betsy Whitehill of my staff at 702-784-5227.

Sincerely,

Randy M. McHatt

David L. Harlow
Field Supervisor

Attachment

CITY OF ELKO

D. GEORGE CORNER, Mayor
TERRY J. REYNOLDS, City Manager
GIULIANA MURPHY, City Clerk
WILLIAM KNIGHT, City Engineer
DENNIS PETERSEN, Building Inspector

1751 College Avenue • Elko, Nevada 89801 • (702) 738-5176 or 738-4213

April 23, 1986

Col. Wayne Scholl
District Engineer
U.S. Army Engineer District
650 Capitol Mall
Sacramento, CA 95814

Dear Col. Scholl:

The City of Elko, by Resolution adopted April 22, 1986, has concurred to a Reconnaissance Study and our willingness to consider further cost sharing of flood control improvements beyond this stage.

Attached herewith for your consideration is a Resolution unanimously approved by the Elko Board of Supervisors consenting to participating with the U.S. Corp of Engineers in a flood area study within the boundaries of the City limits and the Humboldt River.

The City of Elko appreciates the opportunity to assist you by providing you any mapping that we have on file.

Thank you for your kind consideration.

Sincerely,

D. George Corner

D. George Corner
Mayor - City of Elko

DGC/sw

CITY OF ELKO

RESOLUTION NO. 6-86

RESOLUTION CONSENTING TO PARTICIPATING
WITH U.S. CORP OF ENGINEERS
ON IMPROVEMENTS FOR FLOOD
CONTROLS ON THE HUMBOLDT RIVER

WHEREAS the City of Elko, County of Elko, State of Nevada, desires to have the U.S. Corp of Engineers prepare a Reconnaissance Study to identify problems, determine solutions and estimate costs along the floodway of the Humboldt River at no expense to the City;

WHEREAS the City of Elko will cooperate with the U.S. Corp of Engineers in providing known information and notify them of problems associated with the flood area on the Humboldt River within its City limits through its Engineering Department;

WHEREAS the Board of Supervisors of the City of Elko desire to give further consideration to cost sharing improvements of flood control and related purposes;

NOW, THEREFORE, be it resolved by the Board of Supervisors of the City of Elko do hereby consent to the U.S. Corp of Engineers to begin its Reconnaisance Study along the Humboldt River within the boundaries of the City limits.

Dated this 22nd day of April, 1986.

D. George Corner

D. GEORGE CORNER, MAYOR

ATTEST:

Giuliana Murphy

GIULIANA MURPHY, CITY CLERK

VOTE:

AYES: Mayor, D. George Corner; Supervisors: Dick Snyder, Marvin Churchfield Barbara Errecart, Robert McBride

NAYES: None

ABSENT: None